Vol. 8.] 1937. [No. 3.

AGRICULTURAL JOURNAL

Issued by the
Department of Agriculture, Fiji.

PRICE, ONE SHILLING.

BY AUTHORITY: H. R. CRAIGIE, ACTING GOVERNMENT PRINTER, SUVA.
1937.

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DEPARTMENT OF AGRICULTURE, FIJI.

VOL. 8.] JULY, 1937. [No. 3.

EDITORIAL.

THIS number of the *Agricultural Journal* opens with a note regarding the retirement of Mr. H. W. Simmonds, O.B.E., F.R.E.S., Government Entomologist, from the Department of Agriculture after sixteen years of valuable work and loyal service.

It also contains an informative article by experienced officers of the Veterinary staff on the keeping of pigs in Fiji.

This industry needs stimulation in order to reduce our imports of pork and to augment supplies of cheap meat so that the natives may be enabled to vary their diet more than they do at present for their general physical welfare.

The article indicates the best breeds of pig to suit local environmental conditions, describes the essentials of sanitary housing and stresses the need for clean water.

The necessary food components are mentioned and the need for a balanced food ration is emphasised if the best results are to be obtained.

Brief notes are added indicating the chief diseases which occur locally and methods of controlling them.

There can be little hesitation is stating that if the general instructions contained in this article are reasonably followed pig raising locally should prove a profitable side-line for dairy farmers and others.

An interesting comparison of the effectiveness of certain lures used in the trapping of fruit flies, is described by the Government Entomologist. The experiments show definitely that under local conditions the Queensland lure is the most efficient.

Some notes regarding the ability of Fijians as agriculturists are compiled by Mr. W. L. Parham, who has had much valuable experience in the working of Fijians and no little success in instructing them in the elements of agricultural practice.

He indicates the chief difficulties which confront the average Fijian who, given the incentive of a steady market, would undoubtedly prove himself a producer of raw products of no mean order.

He also mentions a few points which demonstrate the utility of small agricultural substations which this Department is now endeavouring to establish in Fijian areas and indicates the potentialities of the native as a self-reliant settler on his own land.

The Department of Agriculture is taking a lively interest in settling Fijians on their lands, as it is considered that this practice will ultimately prove of most value to the race.

In a short article by Mr. C. M. Dass, Senior Indian Field Assistant, the history of the evolution of the hybrid cotton No. 172 is traced. This cotton has been developed to suit local environmental conditions under which it gives heavy crops and it also proves of good marketable quality in England.

Mr. Dass has had long experience with cotton breeding work and this account should be of general interest as the hybrid No. 172 is likely to prove a valuable asset to the Colony.

As a result of a recent visit to Australia Mr. B. E. V. Parham has compiled for this issue a few useful notes regarding Queensland forest trees of potential value to Fiji.

It may be stated that seeds of most of the trees mentioned have already been obtained for trial in Fiji.

A brief description of an attempt to acclimatise the famous spartina grass to local conditions for the purposes of consolidating soil adjacent to rivers, lakes, drains, &c., is provided by Mr. Surridge and is of general interest as a record of the work.

The Inspector of Produce (Mr. A. B. Ackland) gives a short summary of the position of the banana export trade which should prove of general interest to the public, to shippers, and especially to commercial firms, since it is well recognised that the Fijians put their banana sales' money into very quick circulation. The loss of the Australian market has been a heavy blow to the local banana industry, the quota system has stabilised the trade in New Zealand, and there are limited prospects for the development of the banana trade with Canada.

The importation from Hawaii of another parasite of potential utility is reported by Mr. Simmonds in a brief note on the "Fruit Fly." Already some colonies of the new parasite (*Dirhinus sp.*) have been distributed to certain areas.

The local Indian method of extracting coconut oil is briefly described by Mr. S. Ramjan, Indian Field Assistant, and may prove useful as well as interesting.

In a note on the lime requirement of Fijian soils Mr. Blackie (Government Chemist) records the intensity of the acidity and shows that this varies little with depth of soil. He indicates that the lime requirement in Fiji varies from two to seven and a half tons per acre but that it is usually unnecessary completely to neutralise the acidity. Light dressings of lime, however, improve our soils and for bananas, sugar, citrus, &c., up to five tons per acre proves advantageous. Our pastures would benefit by liming but at present the high cost of lime would render useful applications of doubtful economic value.

Some brief but interesting notes on samples of soils from Koro and Lau by Messrs Blackie and Charlton prove that these areas contain rich fertile lands very suitable for many crop plants and it has formerly been noted that bananas from Koro are of excellent quality and unusually free of disease.

Some aspects of copra improvement are put forward in a short article which indicates that instruction aiming at the general practice of improved methods has made material progress and promises to develop further.

One of the main causes of the inferiority of South Seas copra is known to be the result of the practice of Fijians of selling "green copra" to Indian or Chinese shopkeepers for curing mainly by primitive, and often insanitary methods which should be discouraged drastically.

Means for discouragement of this mal-practice are available but have not in the past been enforced and it is now considered that with the tendency of the Fijians towards more independence they should welcome the opportunity of doing their own work, particularly as by so doing their personal remuneration would be materially enhanced.

The Department of Agriculture aims at the betterment of the Fijian agriculturist and with this end in view will continue to strive for the improvement of the copra industry which provides a crop essentially suited to the temperament of the Fijian. The crop also proves remunerative and of interest to a number of European planters, who are anxious to help in its improvement and who would generally favour some form of compulsory grading with a view to improving the reputation of the Colony combined with some enhancement of financial returns.

An interesting account of the present position of the Colonial Sugar Refining Company's Stock Farm at Yanggara is given by Mr. H. M. Stuchbery, Government Veterinary Officer, which indicates what can be accomplished in Fiji with cattle and horses under wise and continuous management.

Some further notes regarding the habits of the giant toad are given, which indicate its usefulness.

And the history of the development of the weed known as the "curse," is traced together with the methods which enabled it to be controlled.

New Public Health Regulations have recently been published and are of particular interest to dairy farmers in that the regulations are now made to apply to the entire Colony whereas previously they only applied to the Suva area. Hence all dairy farmers should study them carefully for their own benefit.

It may also be remembered that the import of cattle from Australia is temporarily suspended owing to the present epidemic of "Three-day sickness."

In addition, some brief notes of general interest and a few reviews complete this number of the journal which it is hoped will be read with interest.

The Department of Agriculture performs a number of useful and necessary services for the public and for the Government Departments and inquiries on all branches of agricultural work are always welcomed and will be attended to as expeditiously as possible subject to the limitations of staff.

The valuable work performed by the research officers of the Department is generally recognised and much appreciated but little is known of the difficult tasks carried out by the Field Staff under trying conditions which demand much patience and preseverance in dealing with native races.

The organisation of the Department now allows for a European Agricultural Officer in each of five agricultural Divisions into which the Colony has been divided and these officers are always at the disposal of agriculturists of all classes and communication with them is invited.

Under each Agricultural Officer a small number of native and Indian Field Assistants are employed through whom it is hoped much instruction and general assistance to the Fijians and Indians will be rendered.

This subordinate staff is gradually gaining the confidence of the Fijian and it is hoped that agricultural progress will continue as confidence in the Department deepens.

RETIREMENT OF MR. H. W. SIMMONDS.

Mr. H. W. Simmonds, O.B.E., F.R.E.S., came to Fiji in 1919 and in February, 1920 was appointed to the Department of Agriculture, Fiji, as Government Entomologist.

On reaching the age limit, Mr. Simmonds retired in January of this year after 16 years of conscientious, loyal and meritorious service.

At the time of his appointment four major problems were requiring the attention of the Department of Agriculture, namely:—

1. The Scale, *Aspidiotus destructor*, of coconuts.
2. The coconut leaf moth, *Levuana iridescens*, which devastated the coconut crops.
3. The "Curse," *Clidemia hirta*, a weed covering large areas of land.
4. The leaf mining beetle of coconuts, *Promecotheca reichei*.

With regard to the first of these problems, Simmonds was sent to Tahiti where two parasites of the "Scale" were reported to be present and these he successfully introduced to Fiji with greatly beneficial results.

The second problem, the coconut leaf moth (*Levuana iridescens*), had been known in Fiji for some 40 years and Simmonds was despatched to Malaya in 1925 with the object of collecting and preparing for export to Fiji, the parasite, *Ptychomyia remota*, of the moth *Artona catoxantha*. He successfully worked out the life cycle of the parasite in Perak State and arranged for the despatch of a large colony to Fiji, living on 85 coconut seedlings growing in five wire gauze cages. Although some 20,000 larvæ of the *Artona* were shipped, only 315 parasites (*Ptychomyia remota*) reached Fiji alive. From these surviving parasites, numerous large colonies were bred and distributed to make one of the most spectacular successes of entomological history, the *Levuana* pest still being completely under control as a result of this valuable work which is worth many thousands of pounds annually to the Colony.

In 1927 Simmonds brought from Honolulu a colony of the "Lantana" bug, *Teleonemia lantanæ*, which has since materially deterred the spread of this weed in the drier areas though its value in the wet zone is much hampered by long spells of rain.

In 1930 Simmonds proceeded to Trinidad on a mission to introduce a thrips (*Liothrips urichi*) with the object of stemming the rapid progress of the weed, *Clidemia hirta*, known as the "Curse." The insect was successfully introduced and achieved remarkable success over large areas of the weed, which are now replaced by useful herbage with much benefit to dairy farmers and others by the consequent reduction of weeding costs and the resulting better pastures.

In the control of the coconut leaf mining beetle (*Promecotheca reichei*) Simmonds also played a part in conjunction with his colleagues, notably Taylor who successfully introduced the parasite, *Pleurotropes parvulus*, from Java. This parasite continues to render effective control of the beetle.

During a visit to New Zealand Simmonds was able to convince the authorities there that the Mediterranean Fruit Fly did not exist in Fiji and as a result the citrus trade with New Zealand was reopened to the advantage of Fijian producers.

Simmonds performed valuable services in many other investigations concerning pests such as the blue rat tail weed, the cotton stainer, the banana borer, the citrus and guava fruit fly and others and the results of his researches and his numerous scientific publications containing valuable records will long benefit the Colony.

Mr. Simmonds as a man, endeared himself to many friends by his natural charm, modesty, reticence and refinement and counts numerous friends in his profession in many parts of the Globe.

By his colleagues in the Department of Agriculture he has always been very highly esteemed because of his natural traits as well as his immense fund of useful general information on agricultural and horticultural affairs in the Colony, which has always been freely at the disposal of members of the Department and many others.

As a horticulturist, Mr. Simmonds is a keen observer of nature, always maintains a garden full of beautiful blooms, and many of the best type of hibiscus now to be seen in Suva owe their origin to him.

In recognition of the very valuable services to the Colony rendered by Mr. Simmonds, His Majesty King George VI at his Coronation, graciously bestowed on him the honour of the O.B.E. which he justly merits as a fitting conclusion to his loyal service in the Department of Agriculture.

This is the first occasion on which any such honour has been granted to an officer of this Department for services in Fiji and all his colleagues appreciate fully the honour thus bestowed on the Department and heartily unite in congratulations to the worthy recipient.

The staff of the Department tender best wishes to Mr. and Mrs. Simmonds and hope that they may both be long spared to enjoy well-earned retirement in good health, happiness and prosperity.

A METHOD OF MAKING GHEE BY PEASANT FARMERS.

By

SILAS RAM JAN,

Field Assistant, Western Division.

THE milk for ghee making is boiled gently for some two hours or more, and allowed to coool when a few drops of lemon juice are added. The whole is then allowed to form a junket by " souring." Approximately 24 hours after adding the lemon juice the " thick " milk is churned. The implement for churning consists of a split bamboo or a six-sided piece of wood which is rotated rapidly backwards and forwards by a short piece of rope. The violent churning results in the formation of a rather frothy butter on the top of the milk. This " butter " is skimmed off and the churning continued until all " butter " is extracted. During churning, cold water is added to assist in the formation of the butter. The butter is then washed in clean cold water three or four times to remove strong odours, heated, strained and bottled. It should not be over heated at this stage or the flavour will be destroyed and the ghee rendered tasteless.

PIG HUSBANDRY.

By

C. R. TURBET, M.R.C.V.S., B.V.Sc., Senior Veterinary Officer,

and

C. KOSTER, Stock Inspector.

In spite of considerably more interest being shown by dairy farmers in pig raising for the supply of local butchering requirements, it is still found necessary for some pigs to be imported for this purpose. The inference from this is that the local pig raising industry is capable of being extended.

Further, when normal local requirements are satisfied by locally bred pigs, it would appear that by judicious propaganda among housewives the local consumption of fresh pork could be greatly increased beyond what is, at present, considered as the saturation point. For instance, if each family in Suva alone had one more meal of pork each week than they are having at present, it is evident that a large number of extra pigs would be required to satisfy such increased consumption. In fact, why not eat more pork and less mutton. The aim of pig husbandry should be to make Fiji self supporting in pork requirements and the industry profitable to those engaged in it. Sheep mutton on the other hand must be imported since at present, Fiji produces little mutton and sheep breeding is not likely to develop with any great rapidity.

The retail prices of pork and mutton are very similar and both meats are equally palatable. Pork however, is marketed much younger in Fiji than the equivalent mutton which is from the carcasses of adult imported sheep. One therefore, purchases a more tender cut of meat in purchasing locally bred pork as against imported mutton.

The prosperity of our local people, many of whom derive their livelihood from the land, depends upon their obtaining a good and ready market for their produce and hence a greater consumption of locally bred pork would help materially towards prosperity, even if in a small way.

SUITABLE BREEDS.

To be successful, pig raising must not be carried on in a haphazard manner. It has been ascertained by scientific observation and by practice that successful pig raising in Fiji is dependent upon the adoption of certain methods which have been found suitable to our requirements, the utilization of certain breeds of good foundation stock and the proper control of diseases.

Five breeds of pigs have at times had their waves of popularity in Fiji. A short description of each of these breeds is given below as a matter of general interest.

Tamworth.—This breed has undoubtedly been in Fiji for many years and crosses of the breed are to be seen among the wild pigs of these islands. In fact, of modern domestic pigs the Tamworth breed most resembles the wild pig. This is evidenced by the long legs and snout, hardiness, vigor, muscular strength, and the prolific breeding qualities of the sows. The breed is bright tan in colour. The proportion of lean meat to fat is probably greater in this breed than any other domesticated variety. It is greatly in demand, therefore, as a bacon pig but on the other hand is used for crossings to increase prolificacy and the proportion of lean meat to fat in pigs which tend to the other extreme.

The large white Yorkshire.—For bacon production this pig shares favour with the Tamworth which it resembles in its large size, length of body and the high ratio of lean meat to fat in the carcass. A fair amount of daylight is shown under the body; the face is of medium length and of course, the colour is white. The breed shows a rapid rate of growth and hence early maturity is a strong point in its favour.

The middle white Yorkshire.—This breed is more compact and shows much less daylight underneath than the large white. The face is very short and dished. The length of body in proportion to girth is not so great as in the Large White. The breed is essentially of the fat type of pig and matures early. The colour is white and is noted for its ability to transmit the white colour to the offspring, irrespective of the colour and breed of the pig with which it is mated. This factor is of utmost importance when breeding to supply pigs for pork to a constant market. The adult size of the breed is less than that of the Tamworth or Large White and it is usually classified as a general utility or pork pig.

The Berkshire.—Black skin and hair are distinctive features of this breed which in general conformation somewhat resembles the Middle White. It is a blocky, low set breed of a general utility or pork type and the adult is of medium size. The face is usually very short and dished.

Owing to their black colour as well as to the general excellence of the breed they have been introduced to all tropical and semi-tropical lands where it is generally considered that their black colour proves advantageous in strong sunlight. The breed has long been popular in Fiji.

The Large Black.—Whilst the four breeds already mentioned have rigid ears the "Large Black" is provided with long thin black ears reaching almost to the tip of the nose and drooping well over the face. The skin colour is black. In size the breed does not equal the Tamworth or Large White, nevertheless the pig has great length. The shoulder and jowl are light in proportion to the hind quarters. The lean meat is well proportioned and breed matures early.

All of the above breeds thrive well in Fiji and the actual choice of one of them as a farmer's pig is largely a matter of individual fancy. There are, however, two factors of importance to be considered in deciding which breed is to be utilized. The first is that white pigs are at present in favour with local butchers and the second is the availability of breeding stock. The Large Black is the least common breed both locally and in neighbouring Dominions. The other four breeds mentioned are fairly plentiful, but breeding stock of any breed is difficult to obtain in Fiji and the importation of breeders in the first instance is no doubt the best policy.

On account of the lack of pigment in the skin of white pigs, considerable prejudice formerly existed against these pigs in lands subjected to strong sunshine. This prejudice still exists in some countries where total hours of sunshine are high and where natural shade is scarce, but in Fiji, there is a large proportion of cloud and natural shade is plentiful. Furthermore, the method of housing advocated by the Department of Agriculture and adopted by most pig raisers in Fiji, provides sufficient protection from strong sunlight so that very little trouble is experienced among white pigs from sunburn.

Since there is no bacon industry, pig breeding in Fiji is entirely for the fresh pork trade of and the above mentioned pure breeds, Middle White and Berkshire are probably most suitable. Next in order would come Large White and Large Black which are of about equal merit, whilst the Tamworth is least suited to local conditions. As already mentioned, however, the Tamworth crossed with Middle White or with Berkshire provides a very suitable pig for the pork trade.

HOUSING.

Because of the presence of the kidney worm of swine in Fiji, it is necessary to modify the usual methods of pig husbandry as practised in other countries. It has been observed that where pigs are allowed access to the usual type of earth floored pig run or paddock, sooner or later the earth becomes infected with eggs or larvæ of the kidney worm as well as other intestinal parasites and it becomes an uneconomic business to attempt to raise swine for the butchering trade on such land.

A type of housing suitable to the particular requirements of Fiji has been evolved and adopted by practically all farmers who supply local butchers. The essential feature of this housing is that concrete floored sties are provided and fitted with adequate protection from sun and rain and the means of frequent flushing with clean water. Particulars of these sties are available on application to the Department of Agriculture. The sows farrow in these pens and remain with the litter until the latter was weaned. At no time are the young allowed out of the concrete floored sty. After weaning the sow may be allowed out to graze. The young pigs on the other hand are confined in the sty at all times. Should the litter be a large one, it will become necessary to divide the litter as they grow in order to prevent overcrowding in a sty. The young pigs are kept in these concrete floored sties until they are ready for marketing at about six months of age.

Formerly the writers advocated that all pigs, including boars and sows, should be confined to the sties. Although this practice has advantages in the control of kidney worm, there are certain disadvantages to be considered so that now the original plan is modified to allow both boars and sows some grazing. These adult animals however, should be provided with adequate sanitary sties.

A well laid concrete floor is essential in a sanitary sty. The partitions and walls may be made of one of several types of material to suit the pocket or fancy of the owner. Among these may be mentioned concrete, sheet or corrugated iron fixed to wooden or iron frames, wood and strong pig wire. The advantage of the solid type of end walls and partition is that of isolation and rigidity. A disadvantage is that the solid walls may tend to make the pens hot. When partitions of pig wire are used there is free ventilation and so the sties are cooler. This, however, breaks down the isolation between sties, so that in the event of disease appearing it is spread more easily from sty to sty. The end and back walls at least of a unit of sties should be of solid material to provide shelter from cold winds to which pigs generally show low resistance.

About half the total floor space of the sties should be roofed, as a protection against both rain and sun. When an iron roof is used, it is well to cover the iron with cut grass or coconut leaves as an insulation against excessive heating of the iron on days of strong sunlight.

The floor area of a pen or sty capable of housing a sow with her litter should be about 100 square feet. A convenient dimension would be 13 feet by 8 feet. Subsequent to the weaning of the piglets their number in any one pen should gradually be reduced as they grow so that not more than six pigs are contained in a pen when ready for the butcher, *i.e.*, at about 100 lb weight.

At one time a removable wooden sleeping floor was advised at one end of the pen under the shelter of the roof. It is now found that the floor is unnecessary, the pigs doing quite well on plain concrete. This means a considerable saving in the cost of construction of the sty.

To get the best and most economical growth, pigs should not be exposed to excessive rain and dampness. To avoid this the floor of the sty must be

given sufficient slope to allow fluids to run off quickly. The slope should be from back of the sty to the front, when the back is the covered portion. The pigs will then have reasonably dry sleeping quarters under the roof.

Housed in sties of the type mentioned above it will be found that pigs have reasonably clean habits. They will always go to one part of the sty to get rid of their excreta. Feeding arrangements should be in the front of the sty for convenience in operating.

There is some danger of heavy sows killing young piglets by crushing them between their body and the wall of the sty. To avoid this accident, it is well to provide a guard rail of two inch round iron piping or wood around the sides of the farrowing pen placed at a distance of nine inches from the wall and at a height of about nine inches from the floor. This buffer serves adequately to protect the young pigs from being crushed.

Drainage from the floor of the sties should be allowed to flow into a common open cement drain outside the sties leading to a covered liquid manure tank. The adoption of this type of disposal of pen washings will help to keep down flies and other vermin as well as provide a convenient source of garden manure.

An abundant supply of clean water is a very necessary adjunct to every pig sty and will result in healthy pigs being produced with a minimum of drudgery. It is essential, in fact, for the control of the kidney worm.

It has already been mentioned that an open run with grazing may be provided for breeding sows and for the boar. The difficulty is to keep this exposed earth free from kidney worm infection. The area therefore, should not be overstocked. Swamps, damp corners and mud holes should not be included in its boundaries. An open porous or sandy soil is best but difficult to obtain in many districts in Fiji.

FEEDING.

Since it is advised that young pigs should be entirely raised on concrete they become dependent upon man for their existence, growth, and development. They are unable to select their food or to balance their ration. The pig owner must therefore provide sufficient food containing the correct proportion of contained nutrients.

The essential components of food consist of several different compounds and elements including proteins, carbohydrates (starch and sugar), fats, minerals, vitamins and water. Some food are rich in one of these ingredients whilst poor in another, thus, giving a badly balanced food ration. When a food has the various components present in the correct proportion for the best utilization of the food by the body it is said to be well balanced. The balance of food relates to the proportion of digestible protein to the digestible starch plus the heat equivalent of the fat. This is expressed as the nutritive ratio. The other components, minerals, vitamins and water must be present in sufficient quantity. In addition to being present in sufficient quantity, lime and phosphorus for the growing pig should occur in about equal quantity.

Because it is desirable that young pigs should grow rapidly, the proportion of protein to carbohydrate and fat, (*i.e.*, the nutritive ratio) should be high since protein enters largely into the production of flesh and other animal tissues except fat. At the same time because of the rapid growth of the pig, minerals should be abundantly supplied to allow for good development of bone and blood.

As the young pig grows towards maturity the nutritive ratio of the food should become gradually wider, in other words less protein food is required in proportion to starch, sugars, and flats. Simply stated, this means that

young pigs being raised for market require much richer food than say the adult boar or weaned sow. The pregnant sow and the sow with litter requires rich food, since she is providing for the nutrition of other bodies that her own.

The farmer will wonder how he is going to balance the pig's food without knowledge of the chemical constituents of the food and his difficulty is appreciated. What has already been written rather indicates a scientific ideal for pig breeders but also it gives a basis for thought in computing a balanced ration, an illustration of which will later be given for a 40-lb pig.

In the meantime a table of locally available food stuffs computed on a basis of 100 lb of each material will not be out of place.

TABLE A.

Feeding stuff.	Dry matter.	Total digestible nutrients.			Nutritive ratio.	Mineral Ash.
		Crude protein.	Carbo Hydrate.	Fat.		
100 lb	lb	lb	lb	lb		lb
Meat tankage ..	92·5	58·0	..	12·7	1: 0·6	10·5
Skimmed milk ..	9·9	3·1	4·6	0·9	1: 2·1	0·7
Coconut meal ..	92·3	18·4	37·6	17·1	1: 4·1	5·7
Pumpkin (field) ..	8·3	1·1	4·5	0·5	1: 5·1	0·9
Crushed maize ..	88·7	6·9	69·0	3·5	1: 11·1	1·3
Para grass	27·2	0·8	14·0	0·3	1: 18·4	6·6
Kumalas	31	0·9	24·2	0·3	1: 27·7	1·1
Cassava	32·6	0·6	26·4	0·2	1: 44	1·0
Molasses, (cane) ..	74·2	1·0	58·2	..	1: 58·2	6·4
Bananas, (green) ..		Analysis not available.				

The above foods are placed in their order of richness as shown by their nutritive ratios. Although skimmed milk and field pumpkin appear high in the list, the proportion of dry matter to water is low. In skimmed milk also there is too much protein as compared with carbohydrate and fat, *i.e.*, the nutritive ratio is too close.

Perusal of the list indicates that crushed maize is rich in these latter two ingredients *i.e.*, the nutritive ratio at 1: 11·1 is too wide. It will be seen therefore, that by feeding skimmed milk and crushed maize, in correct proportion that a ration of correct nutritive ratio can be obtained.

An example of such a ration is as follows:—To feed a pig of 40 lb a correctly balanced daily ration of 2·33 lb of total dry matter having a nutritive ratio of 1: 4·4 (which is approximately correct for the size of pig selected for illustration) quantities as set out in the following scale would be required:—

TABLE B.

Feeding stuff.	Total feed.	Total dry matter.	Crude protein	Carbo-hydrate.	Fat.
		lb	lb	lb	lb
Skimmed milk ..	1 gallon	1	0·31	0·46	0·09
Crushed maize ..	1½ lb	1·33	0·103	1·035	0·0525
Total ..	..	2·33	0·413	1·495	0·1425

$$\text{Nutritive ratio} = \frac{\text{Carbohydrate} + (\text{fat} \times 2{\cdot}25)}{\text{Protein}}$$

$$= \frac{1{\cdot}495 + (\cdot1425 \times 2{\cdot}25)}{\cdot413}$$

$$= \frac{1{\cdot}8156}{\cdot413} = \frac{4{\cdot}4}{1}$$

This ration as it stands appears to be a good one. It is not quite correct however because maize is particularly poor in calcium (lime) and rich in phosphorus. The ration would therefore, contain too much phosphorus as compared with lime. The effect of this after prolonged feeding might cause a disease of the bones of the pig resulting in paralysis of the hind quarters. The above ration should therefore be adjusted by adding lime or ground limestone in the form of a lick or direct to each feed. Some green feed should also be added to the ration as a source of roughage or crude fibre and of vitamins present in that type of food.

Without going so far as to have a ration balanced with mathematical exactness, a farmer, by reference to Table A, can form a very fair idea as to whether he is balancing the ration or not. For instance, if he selects meat tankage as one food stuff he should go low in the list for selection of other food stuffs of the ration, *i.e.*, meat tankage, crushed maize, kumalas, or cassava.

In this brief article it is not possible to prescribe a ration suitable to all farmers since feeding stuffs available to each will vary but the Veterinary Division of the Department of Agriculture will formulate for inquirers, balanced rations for growing pigs to suit available food stuffs.

DISEASES.

Few countries are so fortunate as Fiji in the absence of acute infectious diseases of animals including pigs. Those diseases which are present may be controlled so that practically no loss from disease should occur under good management.

Tuberculosis.—When this disease is not controlled losses by condemnation of carcasses at slaughter-houses will be experienced. Infection in pigs is usually traceable to feeding pigs unsterilized skim milk from cows infected with tuberculosis. Therefore, to eliminate the disease from the piggery, it is necessary first to eliminate it from the cow herd, or to sterilize the skim milk by boiling it before feeding it to the pigs.

In spite of the above precautions, heavy infection of pigs with tuberculosis has been found in a few instances in Fiji where infection has not been from feed but from contact with other infected pigs. In these cases no milk was fed. Where infection of this type occurs the disease can be eliminated by applying the tuberculin test to the herd and eliminating those animals found to be infected. The sties should be sterilized by washing with disinfectants and by putting the blow lamp flame over wood work and feeding troughs.

Posterior paralysis.—It has been found that this disease in Fiji may be due to one of two causes or both of these may act together. Severe infestation with the kidney worm may cause it but more commonly it is the result of mineral deficiency or an ill-balance of the lime and phosphorus present in the diet. To avoid the occurrence of this disease it is well to add a small quantity of mineral mixture to each feed as a routine procedure.

A suitable mixture for this purpose would be:—

Sterilized bone meal	40 lb
Air slaked lime..	40 lb
Common salt	19 lb
Sulphate of iron	1 lb

This mineral mixture may be added to the feed at the rate of one pound to each 100 lb of feed mixture, calculated on a dry basis, (for instance one gallon of skimmed milk is equal to one pound of dry food). The mineral mixture should be thoroughly incorporated in the general ration so that all pigs receive their proper share.

Pigs already infected with posterior paralysis should receive the above mixture but such animals should also be provided with a soft comfortable bed of dry grass. Food and water should be made easily accessible to the diseased animals.

Kidney worm Disease.—This is the most serious disease of pigs in Fiji where special precautions are not taken to control it. On the other hand when proper sanitary measures are taken practically no losses should be experienced.

The female worm lays her eggs in cysts which open into the uretors of the pig. The eggs therefore, pass out of the body by way of the urine and so contaminate the surrounding floor. Fortunately, the egg cannot immediately reinfect another pig as it takes from 24–36 hours for the egg to hatch and the young embryo worm is not able to reinfect another host until four more days elapse. The infective larvæ may live under damp conditions for up to five months. Infection of the host may be through the mouth or skin.

From the above it will be observed that if the pigs are kept on concrete floored sties and these sties are cleaned thoroughly by flushing with water more often than once in five days, no embryo worms will reach the infective stage and so infection will not occur.

Open earth floored yards in which adult breeding stock are allowed to run should be well drained and maintained free from swamp areas and mud holes. The earth in these yards and more particularly areas where pigs are accustomed to urinate may advantageously be sprayed with 10 per cent. solution of copper sulphate (blue stone) at the rate of ten gallons per 100 square yards. By this treatment the larvæ of the parasite are killed without harmful effect to pigs inhabiting the land.

That young pigs can be raised for the butcher free of Stephanurus (Kidney worm) infection in spite of association with infected mothers has been conclusively demonstrated in Fiji. The absolute prevention of the ultimate occurrence of the disease on adult stock cannot be assured when the system of partial housing and partial freedom in open pasture is adopted. Nevertheless this latter practice is reasonable with adult stock. They will breed many litters before falling victim to the disease and by adopting the above suggestion of spraying the yards and of eliminating wet places, almost complete freedom should be experienced.

Intestinal worms.—Infestation with these parasites may make pig raising totally unprofitable. However, the adoption of the same measures as are described for the control of the kidney worm will result in freedom from intestinal worms.

CONCLUSION.

Pig raising for the local fresh pork market in Fiji is a profitable side line for dairy farmers when conducted on lines described in this paper. The local market is not yet fully supplied but the extent of development for the above market is limited.

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FRUIT FLY TRAPPING EXPERIMENTS.

By A.M.L.

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At the suggestion of the Director of Agriculture the following fruit fly trapping experiments designed by the writer, were carried out at Nasinu Citrus Station, where Mr. H. R. Surridge, Agricultural Officer, South, supervised the field work.

Whilst trapping the common Fijian fruit fly in an ordinary glass trap, using the Queensland lure (Scrubbs Ammonia, Vanilla and water) has given encouraging results, it was decided to test the value of this lure, as opposed to Clensol and Pollard which have proved of value against other species elsewhere.

In these experiments *Chætodacus passifloræ* was the only commercial fruit fly captured, although in Suva *Ch. xanthodes* has been found to come readily to the same lure. The work was carried out during the whole month of March, when fruit fly in guava fruit probably reaches its maximum.

The traps were used with and without trays and the results are tabulated as follows. A large number of Sarcophagids were also captured, as well as a few other flies, wasps, ants, &c. The pollard being the least specific in its attractiveness and the Queensland lure the most so.

TRAPPING RESULTS WITH TRAY.

Queensland lure.			Pollard.			Clensol.		
Male.	Female.	Ind.	Male.	Female.	Ind.	Male.	Female.	Ind.
18	438	26	34	181	0	13	39	0
482			215			52		
% F = 96			% F = 84			% F = 75		

TRAPPING RESULTS WITHOUT TRAY.

Queensland lure.			Pollard.			Clensol.		
53	526	5	29	100	0	10	41	0
584			129			51		
% F = 91			% F = 77			% F = 80		
			Totals.					
71	964	31	63	281	0	23	80	0
1,066			Grand total. 344			103		

It will thus be seen that the Ammonia-Vanilla gave a total of 1,066 as compared to 344 for the pollard and 103 for the Clensol. The percentage of females was also higher for this lure, being from 90–96 per cent. as compared to 77–84 per cent. for pollard and 75–80 per cent. for Clensol. The presence or absence of the tray beneath the traps made no appreciable difference.

Condition of Females.—An examination was made of one batch of females to ascertain the condition of the ovaries, the batch being trapped with the Ammonia-Vanilla lure and consisting of fourteen females and one male.

Of the fourteen females, five had full ovaries ready to oviposit, three had six or more ripe eggs, three had fewer than six ripe eggs and the remaining three had small partially developed ova only.

Queensland lure without vanilla.—As it had been stated that, in Queensland, it had been found that the vanilla was unessential in this lure it was decided to test this statement also. The results were interesting, the Ammonia-Vanilla giving 83 males, 923 females and 13 indetermined, a total of 1,019, whilst without the vanilla only 48 males, 396 females, and 3 indetermined, or a total of 447 were trapped. It will thus be seen that the vanilla doubled the efficiency of the lure.

It thus becomes evident that in the so called Queensland lure, (Ammonia-Vanilla) an attractant of very considerable efficiency is available, especially so to the females, as indicated by their large proportion in the traps intercepted prior to ovipositing. It is also of interest to note that the only commercial fly taken at Nasinu, merely nine miles from Suva, is *Ch. passifloræ* and the *Ch. xanthodes* which has at times been the dominant species in the Suva traps, when using the same lures, has not once been taken. As this species has been recorded as present in Fiji for many years and as it uses both the guava and the granadilla in which to oviposit particularly the latter, it is puzzling to understand why it should not be in evidence at such a little distance from Suva, not one having been seen amongst the thousands of fruit flies examined in the past four years.

The Queensland lure consists of Scrubbs Ammonia, Vanilla and water in the proportion 1 tablespoonful ammonia, 1 teaspoonful Vanilla, and 1½ pint water.

THE FIJIANS AS AGRICULTURISTS.

By
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Agricultural Officer, East.

In the Fijian's own language, he is commonly styled the "taukei" (owner) denoting his status as owner of the bulk of the land in the Colony. It is almost safe to say that the average Fijian feels still a sort of right to lands alienated before Britain took charge and terminated the sales of land.

During the sixty years since the Cession the Government has followed the policy of endeavouring to increase the variety,, and the quantity of commercial crops grown by the Fijians. Within recent years the Department of Agriculture has been particularly active in providing instruction, and in assisting the natives with the marketing of their produce. But to critics who assume that such interest is being displayed late in the day, one must repeat that these activities of to-day are but the present form taken by the same interest in the natives' welfare that caused Sir Arthur Gordon to organise the growing of tax crops. In passing, one may mention that in the cultivation by Fijians of tobacco, maize, and cotton there are still many evidences of the value of the instruction given whilst that system of taxation was in force in Fiji. Indeed some Fijians ask for a revival of the system. This reflects credit both on the quality of the instruction given, and on the ability of the Fijians to absorb it.

Yet it is evident to the most superficial observer that the natives are not making reasonably full use of their lands. The reasons for this are so controversial, as well as so varied that they cannot be dealt with in this article.

Briefly the difficulties of the ambitious Fijian may be listed as:—

(*a*) want of incentive;
(*b*) ignorance of implemental agriculture:
(*c*) restrictions of the communal system;
(*d*) impossibility of being thrifty in the face of native custom;
(*e*) inferiority complex.

The rapidly improving system of communications in Viti Levu at least, is bringing both new desires and new burdens on the Fijian—thus gradually providing the incentive lacking hitherto. For instance, it is evident even to the hospitable Fijians that villages on the main roads cannot welcome non-paying guests; so the way-faring native nowadays either has to possess money or else starve—"kana wai" being the current term for soothing the pangs of hunger by drinking water.

The Agricultural Instruction of the Fijians in their own homes is being so rapidly organised by the Department of Agriculture that soon no Fijian need plead ignorance. A large staff of trained native assistants are now engaged in most parts of the Colony working under the supervision of European Officers, Demonstration plots (substations) are being established at key points, so as to give practical proof of the possibilities of crops new to the areas concerned. In instance of the practical utility of substations some of the work carried out by the Fijian staff of the Demonstration Farm at Ndombuilevu in Ra Province, may be mentioned. This substation was commenced seven months ago, with a staff of one Native Field Assistant and two native students. The reports include the following:—

(*a*) instruction in cotton growing throughout the province;
(*b*) organisation of a settlement of fourteen Fijians;
(*c*) supplying of seed to Indians, and to Fijians;
(*d*) roadside ornamental plantings;
(*e*) growing and supply of nursery plants;

(*f*) growing of experimental plots of cotton;
(*g*) successful liberation of Giant Toad (*Bufo Marinus*);
(*h*) collection for identification of diseased leaf specimens of the coconut acutely attacked by Scale (*Aspidiotus destructor*, Sign.), and liberation of the necessary parasites;
(*i*) erection of house and store and the planting of food crops;
(*j*) making of drains, triangulation of area, &c.

The restrictions of the communal system and of native customs are self evident, but their discussion is beyond the scope of this journal.

What may be termed the " inferiority complex " of the Fijian is passing rapidly; but it has been, and will continue to be a drawback that so many Fijians themselves refuse to believe their race capable of competing with the immigrant races. This is particularly noticeable in the cases of men of rank and of power who have reasons of self-interest for desiring the maintenance of old ways, and so find temptation to discourage the hopes of the ambitious. Such pessimism is seldom insincere and is noticeable also as regards many Europeans with long experience with Fijians. The commonest remarks heard about Fijians comment on their laziness, wastefulness, ignorance, and want of ambition. Too often there are good reasons for such comments, but often also one is inclined to wonder how one's own race would fare under similar conditions. The Fijian race is facing a critical epoch, and requires all the friendly encouragement possible. In agriculture the officers of the Field Division of the Department of Agriculture find much to do in stimulating, and in maintaining the desirable ambitions of the Fijians. But it would be impossible to do this, if one did not know of the potentialities of the natives as agriculturists.

In the first place the Fijian is an expert gardener with a thorough inherited knowledge of the needs of every crop customarily grown in his home district. Planting methods vary greatly from Province to Province. and always with good reason. For instance kumalas (sweet potatoes) are generally planted on mounds, but in certain dry districts are set first in holes to provide them with shade; and finally are hilled up with the onset of the rains.

The most spectacular evidence of Fijian skill is to be seen in many extensive terraces in some of the hill districts. In grass country one may observe whole hill-sides terraced and with complete irrigation systems; including the provision of bamboo pipes where necessary. Carefully designed dams were made, and planted with shrubs for strengthening purposes. It is no exaggeration to say that such terrace systems extend for miles, and though many are visible on grassy slopes, yet many more are hidden by forest growth. A few of these terraces are still utilised by the few modern representatives of the numerous families which once maintained these extensive gardens.

In connection with these terraces it is interesting to find that a system of rotation had once been practised. Ndalo was the main crop but at times the terraces were dried off and planted with yams.

Another commendable practice still to be seen commonly in the hill districts is the building of bamboo palisades on steep hillsides to retain the soil of yam gardens. In the hill peoples' dialect there is a specific term for these contour barriers to erosion, and it is a purely Fijian idea, yet to all intents it is a practice of modern anti-erosion science which the Department of Agriculture is desirous of bringing into common use by the immigrant agriculturists in the Colony.

The Fijians understand well the varying types of soils and have terms expressive of the differences. Both the top-soil and the sub-soil is considered in selecting land. The quick response of tobacco to soil conditions

has been realised, and the Fijian chooses the soil which will give him any particularly desired result. In a recent discussion over the site of a plot for tobacco the Fijians stated that an alluvial gravel sub-soil was particularly desirable for the crop.

Maintenance of soil fertility was not studied except in the case of ndalo terraces; and these, entailing much skill and labour in their construction, were necessarily worth maintenance. Otherwise the Fijian quite reasonably as he has abundance of land, changes his garden to new sites—abandoning the once or twice cropped land to revert to the wild state, and so become renovated in the course of time.

Another random instance of native skill concerns the planting of bread-fruit suckers. These are very delicate, hence a palm leaf is plaited around each one as a protection.

An extraordinary point about the Fijian in agriculture is that it is the one activity in which he is and was an individualist. Any average Fijian can show where his father or grandfather had gardens, but one hears little or nothing of communal plantings. Such communal activities are and were for specified public purposes only, and any misuse of such for private purposes causes bitter disputes.

Each self-respecting individual is and was dependent on himself for his food supply. The desirable suitor in a Fijian girl's eyes is the industrious gardener, and I have known an aged man win a young wife with general approval for that reason. Formerly the garden was the only place where the native had any home life; and that is largely so still. The Fijian away for a few days on his distant and secluded garden is a very different man from his often languid seeming self in the Koro. With a house usually built convenient to an ample water supply he is in the open air from dawn till dark; and at night there is no crowded social gathering to tempt him to late hours and excessive yanggona. An important detail too is that for the time being, he is altogether his own master and able to plan his work free from unexpected and incessant calls on his time. It is doubtful if a man of any race whatever could ever accomplish much if beset with the incessant frittering away of his time in petty communal duties which cannot all be anticipated and be planned for accordingly.

Much of the Fijian's reputation for laziness has arisen from ignorance of his habits whereas left to himself, the native can undoubtedly fend for himself. The everyday ways of the Fijians are those of any other intelligent and industrious race.

From a wide experience of agricultural instruction amongst the Fijians the writer is convinced of their aptness to learn, but one must have something worth the teaching. For instance careless ploughing was terminated by teaching the English system of dry land ploughing which gave the men a new pride in their work, and they enjoyed it the more that the reasons were practical but not obvious.

There are some of the reasons why one is convinced that from being an expert gardener the native can become an equally expert and successful commercial agriculturist. It is not the intention in this article to deal with the how and the why of the exceptional obstacles with which the Fijian has to contend, but one may point out that, given opportunity, many a native becomes a frugal and a self-reliant settler on his own individual holding. The Department of Agriculture is taking a particular and an increasing interest in such settlers, and it is evident that in the success of these men lies the best hope for their race.

FIJI HYBRID COTTON—NO. 172.

By

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Fiji Hybrid Cotton No. 172 is a type of the large family of economic plants, known as Gossypium, that was especially bred to suit Fiji conditions. As during the present season approximately two hundred acres of it have been planted it may be of interest to trace its origin and history. This brief description will perhaps convey to the layman something of the magnitude of the task in evolving a single type of cotton that will meet at least most of the requirements of the spinners.

In 1926 Mr. R. R. Anson, the Cotton Specialist then in charge of the Singatoka Experiment Station, received from the Empire Cotton Growing Corporation seed derived from five single plants selected by Colonel Evans (now Sir G. Evans, Principal, Imperial College of Tropical Agriculture) in New Guinea for trial in Fiji. These plants, designated K1, K3, K8, K11 and K24 respectively, were natural hybrids of two types of the Peruvian group. The first type, Kidney, (*Gossypium peruvianum*) possesses a robust bushy plant capable of growing well under very wet conditions and produces lint very short in length and coarse in texture and conglomerate seed—the mass of the seed resembling human kidney in shape whence the cotton derives its name. The Second type, Sea Island (*Gossypium barbedense*) possesses slender, upright plant producing long soft lint, is free seeded, and requires somewhat drier growing conditions.

Two of the New Guinea hybrids, K3 and K8, when tried at the Singatoka Experiment Station were found to possess lint intermediate in character, *i.e.*, moderately long and somewhat less coarse than " Kidney " and the seeds were more or less free. Two selections were made from each type (designated K3–1, K3–2, K8–1 and K8–2) for characters of lint and free—seededness, and were planted in separate blocks for observation and further selection during 1927–28. It may be pointed out that throughout breeding and selection work was guided by a definite policy—that of producing lint suitable for sale in England against super fine Egyptian cottons which commanded a select as well as a comparatively extensive market.

During season 1927–28 it was found that both K3 and K8 selections bred almost true to type, possessed 100 per cent. free seed, had improved in respect to ginning percentage and lint index, but little improvement was noticed in the length and fineness of lint. Multiplication plots were planted with seed obtained from progeny rows of K3–2 and K8–2 selections. K3–2 appeared to be more uniform in habit of growth and general plant construction than K8–2 and was earlier in reaching maturity. The yield of seed cotton obtained was almost double of that of Sea Island. At this juncture it was decided to eliminate K8 type and continue further selection with the K3 type.

Having attained free seededness, slight improvement in the quality of lint and uniformity of plant type, the next step was to effect further improvement the quality of lint without sacrificing yield.

In season 1928–29 ten single plant selections were made from K3–2 type which resulted in marked improvement in the length and fineness of lint. At the same time it was realised that to bring the K3–2 selection up to the standard of superfine Egyptian it would be necessary to introduce a further dose of the Sea Island strain into it. Accordingly five plants of K3–2 were " backcrossed " with Sea Island. These plants were named K3XS1, K3XS2, K3XS3, K3XS4 and K3XS5.

In 1929–30 the backcrosses were set out in five progeny rows. Two hundred and seventy-three plants were obtained as follows:—K3XS1=104 plants; K3XS2=9 plants; K3XS3= 20 plants; K3XS4=43 plants and K3XS5=97 plants. This was the first filial generation of the backcross and contained plants for the most part possessing intermediate character of plant-habit but differing somewhat in lint characters. All plants were self-fertilised, the process requiring daily attention. The plants and their produce were tested individually for fifteen separate characters both in the field and in the laboratory.

During the season 1930–31 the selections were planted into 273 progeny rows, necessitating the testing of over 7,000 plants in the field for plant, flower and boll characters. This being the second filial generation of the backcross the progeny split up into numerous types, most of which were deficient in some important character. Of the 7,000 plants tested in the field 6,500 were eliminated. The remaining five hundred plants or rather seed-cotton obtained from 500 plants was subjected to laboratory tests. Of these 241 plants were obtained from K3XS1 and 259 plants from K3XS5. All plants of K3XS2, K3XS3 and K3XS4 were eliminated.

During the season 1931–32 fourteen pure lines were isolated from five hundred progeny rows, five of the best being K3XS1–127; K3XS5–24; K3XS5–63 and K3XS5–172.

Samples of lint of the five pure lines were sent to England for spinners' reports during 1931–32 and 1932–33. At first K3XS5–24 seemed to be the cotton that would meet their requirements. Their preference then changed over to K3XS5–172. The laboratory tests carried out at the Experiment Station showed that K3XS5–172 was the better cotton of the two.

During the seasons 1932–33, 1933–34, and 1934–35 the backcross (K3XS5–172) was grown on small isolated areas at the Experiment Station along with Nos. 24, 35, 63 and 127. Crossing was however carried a stage further by introducing another dose of Sea Island into the backcross cotton No. 172. The second Backcross cotton was carried through all similar stages of selection and elimination as with the backcross No. 172 but the result has not been very satisfactory so far.

In 1935 the Director of Agriculture decided that single plant selections of the backcross No. 172 should be continued with a view to improving its lint characters since the cotton was considered to be of good marketable quality. Though slight variations existed in the quality and length of the lint it was gratifying to know that the goal set in 1926 had been attained and that a type of cotton has been evolved which continues the robust habit of the " Kidney " with the fineness of lint and other good qualities, of the superfine Egyptian cotton.

This year 1936–37 a number of progeny rows of the backcross or hybrid No. 172 are planted, some of which give promise of improvement in characters such as uniformity in length of staple and fineness of lint. Consideration is also being given to the usefulness of again backcrossing the double backcrosses to Sea Island with a view to increasing the length and fineness of the lint.

NOTES ON SOME QUEENSLAND FOREST SPECIES.

By

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DURING a recent visit to Brisbane, at the suggestion of the Director of Agriculture, Fiji a few inquiries regarding forest species of trees which might be useful for planting in Fiji were made and the present brief note summarizes the information obtained in the short time available.

The Forestry position in Queensland is roughly, that some planting of Exotics (*Pinus radiatus, P. caribæa, P. tæda*) has been done at great expense; but the policy is now entirely abandoned, the Department concentrating on native species. All Australian States are now turning to re-afforestation with native species—not exotics. Growth rates of Fiji kauri which I mentioned were regarded as quite satisfactory; and the failure of seedlings to persist unaided is apparently common to both Fiji and Australia. Recently new methods of handling the young plants of forest species have proved most successful.

Araucaria Cunninghamii (Hoop Pine) is the most important indigenous softwood of Eastern Australia and yields a valuable timber. The timber is used for all indoor work and for mouldings, panellings, ceilings and joinery. It is superior in toughness and strength to imported pinewoods. It is also used for the planking and decking of boats and small vessels. The timber has no odour and is excellent for butter-boxes. Six million super feet of Hoop Pine of flawless quality is annually converted into 3-ply in Queensland. The special value is the even, firm, softwood texture, ease of working, strength and durability; and the timber is non-aromatic and tasteless.

The small trees will not tolerate open root planting without shade—but planting out in tubes has proved 80 per cent. successful and costs about £10 per acre. The seed loses its viability rapidly so that fresh seed is most desirable. The seed is planted in prepared beds which are shaded—late spring planting, *i.e.*, between 15th October and 31st January is desirable—and very poor growth results if planted later than 1st March. This effect is cumulative and affects the subsequent growth over a long period. Tubing a plant consists of enclosing the root system within a metal cylinder (probably bamboo pots would be equally as good). After planting out, weeds must be suppressed for two or three years.

Callitris glauca.—Cypress Pine favours a sandy or loose soil. The timber is durable, is resistant to white ants, and is finding increasing use for flooring and lining. For windbreaks—*Cupressus lusitania* from South Africa has proved most successful One pound of seed would give 30,000 to 40,000 plants. This species is recommended for trial in Fiji.

Agathis Palmerstoni.—Northern Kauri Pine. The timber is softer and lighter than Kauri (N.Z.)—used for cabinet work, joinery, flooring, &c., and for butter boxes. The seed matures in late December and January and falls in late January and February during rains—seed collection is therefore difficult. The viability is much reduced after three weeks hence seed must be sown immediately after collection. Germination takes place in from 8–20 days. Loose sandy loam is most suitable—seed being covered by ¼-inch of sand. Moderate shading is essential during first year. Planting out in tubes has proved 90 per cent. successful.

Grevillia robusta.—Southern Silky Oak. This species shows very rapid growth and seeds well. The timber is mainly used for general building

purposes and for interior fittings giving a most serviceable cabinet wood—defective and short pieces are used extensively for fruit cases. The seedlings should be 3–4 months in nursery and trees should be kept thin and growing freely. This tree would be a cheap proposition in Fiji where it is already known to grow well; and might be particularly useful in several ways, *e.g.*, for early supplies of case timber—for shelter as used in Ceylon. The month old seedleaf seedlings should be transferred to pots (or bamboos). The tap root at this stage is only two inches in length and 90 per cent. survival is generally obtained. A spacing of 11 x 9 feet has been adopted tentatively in Queensland. The growth rate is most vigorous during the first six years, by which it is usually 30 feet high. In Kenya the following record has been made of plantation stands:—

Age.	No. of trees per acre.	Volume per acre under bark.	Height.
16 years	472	2,065 c. ft.	60 feet.

Eucalyptus species.—Several species selected for trial in Fiji are among the most valuable for structural purposes and for re-afforestation. Several of them provide the timbers specified by the Fiji Public Works for building and structural work. The silvicultural requirements of the species are similar. They will not regenerate or develop in shade; being strong light demanders. The seed germinates best in sand the average germination being only 15 per cent. The seedlings should be transferred when two inches high. Forest Service efforts in Queensland are to produce Ironbark girders and pole-trees on as large a scale as possible; Red Stringybark, Tallow wood and Blue Gum are also receiving much attention.

Bush Box—Tristania conferta is regarded as the best Australian hardwood for bridge and wharf decking, for wooden tram rails, &c.,—and makes good bullock-yokes. It is classified as a good second-class general building hardwood. The tree favours sites of heavy continuous rainfall, and at its best becomes a very large tree—140 feet high with a basal girth of 200 inches.

Cardwellia sublimis is a large and massive-trunked tree: and produces the timber known as Northern Silky Oak—a highly ornamental cabinet wood supplying practically the whole of the present demands of the Queensland markets.

The Quondong (*Eleaocarpus sp.*) is already seen occasionally in Fiji. There is a large specimen in the Suva Botanic Gardens. The timber is white, easy to work, cuts cleanly, bends readily and it does not discolour with age. The trees favour the zone of heavy and continuous rainfall: and should produce timber useful for cases, &c.

The Queensland Forestry Department is very well organised and is most efficient and the work being accomplished is of a very high order. There is a wide range of climatic conditions throughout the State and a great variety in the vegetation types—and in many respects forest conditions in places are very similar to those in Fiji.

THE GRASSES SPARTINA TOWNSENDII AND S. BRASILIENSIS IN FIJI.

By

H. R. SURRIDGE, A.R.C.Sc.I., B.Sc.,
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THE grass *Spartina Townsendii* was first observed in 1870 growing along the edge of Southampton Water. It has spread to many of the estuarine waters found along the south coast of England and the North coast of France. The plant is very robust, growing to about three feet high, has a strong rooting system which gives good anchorage and enables it to establish itself quickly and in dense patches under congenial conditions. Flowering commences in August and seed harvest about October–November. The strong rooting system has proved of particular value in that it enables the plant, once established, to quickly consolidate the ground, thus retarding the flow of water thereby causing the deposition of fine silt, &c., which builds up the level of the ground, an average of ten inches per annum being recorded in Holland. In Poole Harbour (Dorset) it has established itself in the comparatively hard mud and gravel flats favouring locations lying between high water mark and about six feet under that line. It is also found on the higher levels known as saltings and odd plants may be found in the seawall at the entrance to Poole Harbour. These characteristics have made it of value in the reclamation schemes on the East Coast of England, in the Zuyder Zee of Holland and elsewhere.

The grass, whether green or as hay, is stated to be palatable to stock.

In July 1933 some 100 planting sets of *S. Townsendii* were received by E. Duncan, Esquire, of Suva and Taveuni, from New Zealand, and handed over to the Department of Agriculture, Suva, for trial and observation to discover what value, if any, this grass would have in building up and reclaiming the mangrove and other mud flats in parts of these tropical islands. The sets were carefully washed in fresh water and planted out at one foot apart in a selected spot of mangrove or " tiri " mud in Walu Bay, Suva, which at high tide was covered with 4 ft.–5 ft. of water, while at low tide the first row was just above the water line.

A month after planting 40 sets were dead. Of the remainder, ten sets were left for further observation at Walu Bay, while 50 sets were transplanted to a sandy mud bank, on the right bank and near the mouth of the Rewa River. Sets were planted at one foot apart from a point one foot above high water mark to one foot below the low water line. Para grass (*Panicum barbinode*) was growing freely one foot above the highest mark of the *Spartina Townsendii*.

Plots were inspected at monthly intervals, those at Walu Bay had died out by December 1933, while those transplanted to the Rewa River gradually died out, only one set was reported as alive a year later, but this had died when the writer visited the plot, on return from leave, in March 1935.

The two sites chosen were not identical or comparative but represented the two main types of soil for which the characteristics of this grass would prove valuable, if establishment was possible.

The mud at Walu Bay was at all times soft and during sunshine was very hot between the falling and rising tides while the water was hot and turbid. At the Rewa River, the " soil " consisted of a mixture of " tiri " mud more or less overlain by river silt and coral sand, the water however, was usually clear with some admixture of fresh water on the falling tide especially when the river was in spate, and temperature would normally be high on the tide rising over the hot sand.

In both cases the contrast with the conditions obtaining in the plants native habitat and those found in Fiji was marked, the writer having—when on leave— specially visited Poole Harbour to note "local" and favourable conditions. In this case water temperatures rarely approach 60° F. and the mud flats were hard by comparison. With the failure of *S.Townsendii*, seed of S. *brasiliensis* was obtained from British Guiana by courtesy of the Department of Agriculture at Georgetown, in 1936, but on sowing failed to germinate. From the reports published in the *Agricultural Journal* of British Guiana Vol. 5, page 277, 1934 and Vol. 7, No. 3, 1936, of this grass it would appear to be more adaptable to tropical conditions.

FRUIT FLY.

By

H. W. SIMMONDS, O.B.E., F.R.E.S.,

Government Entomologist.

THE wild guava season appears to have been shorter this season than usual and this will probably shorten the season for efficient fruit fly work. Trapping experiments have been carried out and the interesting results detailed elsewhere, obtained. Disappointment has, however, been met with in that the parasite, *Tetrastichus giffardianus* which promised so well, and had such a high potential value, seems to have failed to bridge the long season of host shortage in these localities where it has been possible to test it.

Whilst it seems unlikely that it has everywhere failed to do so, the fact that it has failed in the considerable guava areas at Nasinu indicates an inability to cross the host shortage season in numbers sufficient to be of any value in the next guava season when, to be of value, its pressure is required early.

Due to the courtesy of the U.S.A. Department of Agriculture in Hawaii another parasite (*Dirhinus sp.* ?) which attacks the pupal stage of the fly was imported in March 1937. This insect is hardy and probably long-lived. It lacks, however, the high potential value of the *Tetrastichus*, since each puparium attacked yields only one adult, instead of the seven to thirty-five of the smaller species. On the other hand the author finds that it will also attack the house fly pupa, and as such, it will be provided with an alternative host to help it to bridge the season when fruit fly pupaia are practically non-existent. To date the following releases of this species have been made: Nasinu 327, Singatoka 200, Taveuni 90.

The local parasites began to show up in March and a collection made at Nasinu on the 31st March gave a 12½ per cent. parasitism by *Opius fijiensis*, Full. An undetermined chalcid was also bred out of pupæ collected in this district on three or four occasions.

THE BANANA INDUSTRY.

By
A. B. ACKLAND, E.D.,
Inspector of Produce.

THE following is a brief survey of the banana export industry since the commencement of the quota system in 1932.

The beginning of the year 1932 witnessed a heavy fall in values for bananas on the Auckland market, shipments for the first two months realising average prices as follows:—

"Tofua,"	14/1/32	.. ..	19,783 cases,	8s. 0d.	per case.
"Niagara,"	22/1/32	.. ..	1,555 ,,	11s. 0d.	,,
"Karetu,"	2/2/32	.. ..	2,754 ,,	11s. 0d.	,,
"Tofua,"	11/2/32	.. ..	12,288 ,,	6s. 0d.	,,
"Aorangi,"	18/2/32	.. ..	3,066 ,,	5s. 6d.	,,
"Karetu,"	27/2/32	.. ..	3,368 ,,	7s. 6d.	,,

Although there was a slight appreciation thereafter it was not until October of that year that prices exceeded an average of 13s. 6d. per case. The average price realised over the whole year was 10s. 10d. per case. In the meantime a number of buyers had surrendered their licences and retired from the business and the Fijian growers had become extremely dissatisfied with the low prices fixed by the Banana Licence Board, 1s. 6d. per case for four months with an average of 2s. 3d. per case over the whole year, and in many cases refused to cut their fruit.

The fall in values dealt a serious blow to the banana trade of Western Samoa and the Cook Group of which New Zealand has control and on the 3rd June, 1932, a cable was received from the New Zealand Government seeking approval of a restriction scheme which had been discussed semi-officially some months previously. Under this scheme, to which the Fiji Government agreed, Fiji was allotted quotas of 12,000 cases per four-weekly period from January to April and from October to December and 9,600 cases for each period of four weeks from May to September. During 1933 these quantities were increased by 800 cases and 400 cases for each four weeks for the Summer and Winter periods respectively owing to the inability of the Norfolk Island Administration to ship its quota due to lack of transport facilities. Fiji continues to enjoy these additional quantities but it is understood that they may be returned to the Norfolk Administration should transport from that island to New Zealand be provided.

In September 1934 a conference of representatives of all the parties to the agreement was held in Wellington with the result that the claims of the New Zealand controlled groups of islands for a larger share in the market were, of necessity, conceded. The New Zealand Government was unable to agree that the market justified an increase in the total imports permitted, consequently, reductions had to be made in the Fijian and Tongan quotas to provide an increase for Samoa. The reduction was considerable. For 1935 the Fijian summer quota fell by 3,200 cases to 9,600 cases and by 2,400 cases to 7,600 cases for the winter period. Further, the new arrangement provided for reductions to 8,800 cases and 6,800 cases for the summer and winter periods respectively during the years 1936-1939. While the reductions were drastic, Fiji was secured against further reductions until the end of 1939 and became entitled to a share in any increase in the total admitted to New Zealand which any improvement in the market might justify during the period of the agreement. The Colony has been fortunate however, in that the inability of the Samoan Authorities to secure suitable transport for

the additional quantities permitted the transfer of large quantities to Fiji, and it was not until the "Matua" took up the running in September 1936, that the reductions were seriously felt. Since then, however, there have been shortages in the Cook Island quota from which Fiji has benefitted.

The New Zealand Government on representations from this Department of Agriculture, decided that as from the 1st January, 1937, the market could absorb slightly increased quantities and Fiji has been allotted additional quota as under:—

January to September	560	cases for period of 4 weeks.
October	736	,,
November	928	,,
December	1,304	,,

While the operation of this restriction scheme has provided difficulties in the administration of the banana export trade there can be no doubt that it has been of great assistance to the industry and that, without some such form of market control, exports would now be much lower than they are to-day.

A comparison of exports for pre and post quota periods does not show the effects of restriction on the quantities exported as there are other factors such as storms and floods which govern production and export. Thus, exports to New Zealand have not fallen below 136,000 cases in any year since the introduction of the quota whereas for 1930 and 1931, owing to hurricane and flood damage, exports were 84,500 cases and 97,600 cases respectively.

Following decisions reached at the Imperial Economic Conference at Ottawa the Australian market was reopened to Fiji to the extent of approximately 50,000 cases per annum by the reduction of the duty from 8s. 4d. per cental to 2s. 6d. per cental for that quantity. High hopes for an extension of Fiji's market for bananas were entertained but experience has shown that high charges in the Commonwealth, since reduced to some extent, and the heavy production of bananas in Queensland and New South Wales rendered profitable trading impossible except for a few months of the year. An additional handicap has been the uncertainty as to the provision of cooler space in the south bound steamers. The tariff reduction has applied since December 1932 but a total of only 40,245 cases—less than one year's quota—have been shipped from that date until the end of 1936.

The possiblities of the development of a market for bananas in Western Canada have received consideration for some time but it was not until 1932 that trial shipments, five in all, were made. These trials were unsatisfactory and were not followed up and further shipments were not made until shortly after the arrival of the present Director of Agriculture in September, 1934. On December 14th of that year a small shipment of 284 bunches and 74 cases was made and regular monthly shipments have been made since that date with profitable results, the maximum shipment being 2,430 bunches. The total quantity of fruit shipped to Canada from the end of 1934 until the close of December last was 33,384 bunches and 483 cases for which the growers received approximately £3,200 at packing stations. The demand is good, up to 4,000–5,000 bunches monthly, but the trade is hampered by a limitation to one ship per month, and by shortage of cooler accommodation on that ship during certain seasons.

The quality and pack of bananas exported to all destinations has improved considerably during the past few years. In 1932 the average net weight of fruit per case was between 80 and 85 lb, to day-100 lb net would be the average. In 1932 the Fijians produced 64·3 per cent. of all bananas exported

whereas for 1936 the percentage of fruit produced by natives and shipped was 90·2 per cent. There has been a gradual increase in the quantities exported from Viti Levu with a corresponding reduction from outer island areas where copra is the principal money crop the percentages being:—

	Viti Levu percentage.	*Elsewhere. percentage.*
1932	49·4	50·6
1936	66·7	33·3

Whilst the trade is but a shadow of what it was prior to the increase in the Australian tariff in 1921 it still remains a most important industry to the Fijians, particularly those in the inland areas of Viti Levu which are served by the Rewa River and its tributaries. During the past five years the growers have received in excess of £130,000 for their fruit, cases produced locally to the value of over £50,000, have been used, at least £60,000 have been expended in local transport, labour, supervision, &c., while overseas freight has approximated £140,000; and banana inspection fees paid to Government have amounted to £10,200. In addition, the shippers have enjoyed reasonably prosperous years excepting during 1932.

The Group can produce large quantities of good quality fruit provided that markets could be found, and it is unfortunate that the only large market within reasonable distance, Australia, is able to produce practically the whole of her own requirements.

COCONUT OIL EXTRACTION BY PEASANT FARMERS.

By
SILAS RAM JAN,
Field Assistant, Western Division.

The coconuts are husked, slit in halves and grated finely on a " Khurchni " (a serated edged steel tool). The oil is extracted from the grated " meat " by mascerating with hot water. Cold water is added to hasten the separation of the oil. The whole is then strained through wire gauge and the milk allowed to settle overnight. It is considered that twelve hours is sufficient time to allow the raw oil to rise to the surface. The oil is skimmed off in the early morning while still more or less solidified. The utensil containing the " milk " for settling should not be covered, particularly in hot weather as fermentation is induced with consequent frothing over and loss of oil. Then follows the boiling of the oil. The oil must be constantly stirred to prevent burning and the process is complete when a pale clear amber colour is obtained. Cooking takes two to three hours. The husked shell of the nut is used for fuel when cooking the oil as a steady smokeless fire is required. After cooking, the oil is strained through muslin and placed in containers. The oil extracted as above will keep fresh for up to six months in Fiji. About 220 to 250 nuts are required to make four gallons of oil, depending largely on the fineness of grating.

Coconut thus prepared serves as a substitute for " ghee " and to a certain extent mustard oil, and is used in making sweets, curries, &c. Some sections of the Indian community also apply it to the hair and body as do the Fijians.

SOME ASPECTS OF COPRA IMPROVEMENT.

By

L. W. HARWOOD, H.D.A.,
Agricultural Officer, Islands.

DURING the past twelve months efforts have been in progress to interest the Fijians in the method of improving the quality of native copra in the Colony.

These efforts have mainly been concentrated on instruction in the erection and working of small copra driers, which have been found capable of turning out excellent copra provided that the routine of curing, as established by the Department of Agriculture, is reasonably closely followed.

Already over sixty of these kilns have been erected and are functioning satisfactorily and the resultant copra of good quality is gaining a premium of ten shillings per ton over the local prices for ordinary native sun dried copra.

Orders have been received for a further fourteen kilns which will be erected in the course of the next few weeks and it is anticipated that more orders will follow continuously for some time.

As the output of native copra forms approximately sixty-five per cent. of the total output from the Colony, continued improvement of the quality, of native produce should, in the course of time, help to improve the present poor reputation of Fiji's product.

In addition to the actual improvement of the quality of native copra there are several other aspects which affect marketing which are worthy of consideration.

Firstly, before any lasting improvment can be made in the standard of Fiji copra, it would appear essential that the trade in " green copra," whether by licensed or unlicensed dealers, should be prohibited.

There are many planters in the Colony who produce excellent quality copra, either sundried or kiln dried, but who frequently, particularly in the case of the small planters, do not receive any monetary inducement for making a superior grade. This is, seemingly, often due to depreciation of good copra by the admixture with it of inferior produce in an effort to improve the marketing chances of the inferior article. In many districts this bad copra used for mixing with the better quality copra is derived from " green copra " sold by Fijians to the local storekeeper, who may or may not be licensed—most of them are unlicensed. The storekeepers, either Chinese or Indians, dry the " green copra " on their own sun drying platforms (" vatas ") which are often unprotected from rains or poultry, to produce what can generally be classed as poor copra and which is usually misnamed " native copra." Admittedly some buyers of " green copra " make good quality copra but unfortunately in most cases the standard is very low. Sometimes the " green copra " is only left on the " vatas " for one and half or two days when it is removed to make room for more " green copra " and the curing is finished off by mixing it with dry copra in the copra store, which is contrary to Regulations.

Such copra is usually affected with moulds, bacterial sliming and insects. In many cases the " green copra " after arrival at the storekeepers' " vatas," is left in sacks for at least twenty-four hours and often for several days before any drying is done and hence bacterial action has already set in before any drying of the meat has been possible with a consequent reduction in the quality of copra. It is generally recognised that copra prepared in this manner is mainly responsible for the high fatty acid content of so called native copra, which gives the South Seas' product a bad reputation.

Also, much of the Fijians' " green copra " is dried by the shopkeepers by very primitive methods, using " vatas " of poor construction and often of dirty materials. Frequently, the drying is even done on the ground without protection from poultry, dogs, and other domestic animals.

Apart from the poor quality of the copra produced, the Fijian, except near the larger towns, rarely obtains good value for his product from the storekeeper, so that in reality he loses a considerable sum of money annually by the sale of his " green copra." Frequently also the green copra is sold by barter at rates even more unsatisfactory than common cash payments.

Moreover, in addition to the better remuneration the natives would receive for the dried product as compared with the sale of " green copra " the business of drying their own copra should prove a useful occupation of moral value to the Fijian who should be encouraged to do his own work.

Though there are only known to be five " green copra " buying licences, it is well known that practically all small storekeepers, in coconut producing areas, buy this product contrary to the provisions of the copra ordinance, which it is hoped will be more vigorously maintained in the future.

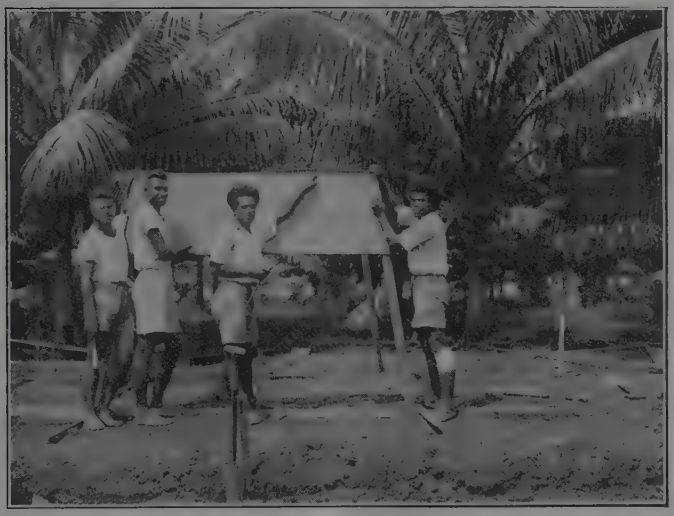
Measures to eliminate or reduce the trade in " green copra " might cause a temporary drop in the output of native copra but this would soon be remedied by the Fijians once they became accustomed to curing their own copra when the better values realised would tend to encourage further plantings and the maintenance of their coconut groves in better condition.

Whole nuts are also often bartered to Chinese storekeepers for goods but the natives rarely receive fair values by this method of disposal of their crops and therefore, it is not in the best interests of the Fijians, who should be encouraged to make their own copra and receive the maximum returns from their plantations and their labours by the use of small driers which they can erect at little cost and operate with ease. Possibly this object could best be attained by provisions in the native regulations forbidding the sale, barter or exchange of nuts or the sale of " green copra " and this matter is under discussion.

Furthermore, more incentive is required to induce planters and natives to produce a better quality of copra than exists at present when large quantities of inferior copra frequently command better prices locally than small parcels of better quality. At present the local merchants have assisted materially by offering a premium of 10s. per ton over local prices for good quality kiln dried native copra and while this is a distinct move in the right direction it is unlikely fully to achieve the main objective of better prices in the world's markets and a better reputation for Fijian copra.

The existing divergence in prices paid on the London market for Fijian (South Seas), Rabaul, Malayan and Ceylon copra clearly indicates that there is room for much improvement locally. For instance, since January, 1934, South Seas copra in London has yielded returns per ton approximately averaging 14 shillings less than Rabaul copra, 22 shillings less than Malayan

SMALL COPRA KILNS UNDER CONSTRUCTION BY FIJIANS AT THE CENTRAL AGRICULTURAL STATION.



EARLY STAGE.

COMPLETE KILN—WITHOUT "MBURE."

copra, and 40 shillings less than Ceylon copra. Thus, South Seas copra is definitely inferior, chiefly because its manufacture is mainly dependent on uncertain weather conditions and because of the habit of dealing in "green copra." There is no reason why Fijian copra should not equal the Rabaul product in London prices or even the Malayan product, with considerable financial benefit to the Colony since if our product was awarded prices equal to those of Rabaul the financial increase to the Colony would approximate £21,000 annually on an output of 30,000 tons (34,500 tons in 1936.) In New Guinea it is claimed that the increased return due to the grading of copra in the last three years has exceeded £15,000 per annum and it is believed that proportionate increases could be obtained locally by the adoption of some form of compulsory grading akin to that in use in Rabaul.

Naturally, general improvement in grade is fraught with many difficulties, but similar difficulties, economic and temperamental, have been overcome in other countries and the present apparent and welcome desire of the Fijians for improved economic conditions should assist in making gradual improvement in the right direction. The majority of the larger planters have already indicated whole-hearted support for any practical measures that can be adopted for the general improvement of our product and would undoubtedly co-operate in any such important movement but the first step is the early suppression of the custom of selling "green copra" to immigrant shopkeepers and the extension of instruction in the preparation of good copra is desirable.

In connection with the copra industry it is necessary to bear in mind that a time may come when inferior copra will not be marketable in competition with copra of better quality and with other interchangeable oils and oil seeds. Also, that the lower the prices for ordianry copra, the wider does the divergence in prices between good and bad copra tend to become except when exceptional conditions exist.

CORRIGENDUM.

In connection with the article on "Small Copra Driers" which appeared in Volume 8, No. 2, of this *Journal*, the top line of page 10 should read: "(7 a.m.). If dull or wet weather prevails, light at one end, a single . . . . . "

AGRICULTURAL DEMONSTRATION STATIONS.

By
B. E. V. PARHAM, M.A.,
Agricultural Officer (Pathology).

DURING recent years it has become increasingly obvious that native agriculture in Fiji has developed a trend towards individualism and independence of effort and whatever the underlying causes of this development may be, it has brought its own particular problems, not only of ways and means but also of methods.

The Field Division of the Department of Agriculture has been actively engaged in the study of these problems for the last few years and has given much assistance by means of advances for the purchase of stock and implements, by marketing of crops grown, by technical advice, by the training of youths in agricultural methods and by the organisation of agricultural schemes for selected men.

Ways and means have not been wanting and in all Provinces there has been an increase in the number of Fijians seeking to devote their whole time to agricultural pursuits on an independent basis and much good work has been accomplished.

Apart, however, from the immediate problems of land tenure, exemption from communal services and the maintenance of ahousehold apart from the village, there are the major problems of efficient land utilization, soil conservation and the substitution of permanent occupation combined with intensive cultivation for the wasteful methods of shifting cultivation and its accompanying evils of dissipated energy, soil erosion and improvement and the difficulties of transport and marketing.

With a view to giving the utmost practical assistance to native cultivators by the dissemination of information and by actual examples of improved methods of soil utilization, Demonstration Stations or Agricultural Substations have been established in several Provinces during the past two years at the instigation of the Director of Agriculture.

The aims of these areas have been to afford occular demonstration of the advantages to be derived from intensive cultivation of a diversity of crops and to stresss the imprtance of the conservation of soil fertility by the use of farmyard manures, rotations, regeneration by green manures, the prevention of waste by use of composts and soil conservation by means of contour planting, terracing, cover-cropping and other methods of preventing erosion on sloping land.

The Demonstration Station is, in a word, a model small-holding worked by a Fijian Field Assistant on a rotational system with crops suited to the particular locality and people.

For example, the Nanduna Demonstration Station on the Waindina River consists of five series of plots under various food, cash and green manure crops with bananas as the main crop; and of one series of permanent crops including citrus, derris, pineapples, annatto, coffee, arecanuts, tea, &c.

The area has been specially selected on a rural thoroughfare and is accessible to all Fijians in the neighbouring districts of Waindina, Viria and Navuakethe and comprises both flat anal and hill-slopes typical of the soil normally cultivated in the Province.

The total area of 15 acres is somewhat larger than that considered possible for one man to manage but this is due to its utilization for trial plantings of useful native and exotic forest trees of which ten species have been established and for field experimental purposes in connection with Departmental projects.

The area has been managed since its inception by a Native Field Assistant of the Department who lives on the area and is available to advise and assist native cultivators in the vicinity with regard to the planting and marketing of crops, &c.

The staion also serves as a seed distributing centre for the surrounding districts and as an information bureau on native agricultural matters, and during 1936 crops of bananas, kumalas, rice, soya bean, maize, ndalo, tapioca yams and ginger were harvested.

During the first working year, the revenue derived from this station amounted to £20 5s. 0d., being made up of sales of produce as follows:— Ndalo £8 16s. 0d., tapioca £8 10s. 0d., kumalas £1 19s. 0d., yams and maize £1.

A solidly constructed building, 24 x 18 feet, having thatched sides and a corrugated iron roof was built to house the Native Assistant and two Fijian student workers at a cost of £39 and it is a credit to their workmanship.

The Field Assistant in charge during 1936 was Meli Rokobici who carried out his duties with ability and in addition he had charge of the adjacent Fijian peasant settlement

This settlement comprises ten native farmers, each with an area of approximately ten acres. These holdings are being worked on a rotational system similar to that of the Demonstration area but with somewhat larger more economic individual unit areas for the various crops.

Each settler lives on his own block of land, rented from the Crown, and has built his own house. Already 15 acres of the settlement have been planted with such crops as bananas, ndalo, yams, tapioca, coconuts, ginger, pine-apples and tobacco whilst rice will shortly be planted on several cleared acres.

These settlers during 1936 exported 348 cases and 309 bunches of bananas, these exports alone relaising £90 7s. 6d., whilst they also marketed ndalo, yams, tapioca and kumalas.

In the early stages the settlers were assisted financially by wages received for work as banana selectors and punt men for Canada banana shipments and for work on the adjacent Demonstration Station. They were further assisted by an advance of £2 worth of planting material and of £4 for purchase of implements.

Exemption from communal duties has been obtained for these settlers who appear to be adjusting themselves readily to the land as independent peasant farmers. Normal precautions are being taken to assure generally satisfactory sanitary measures at this Settlement and every assistance is being given in the matter of marketing produce.

This brief notes serves to show how the adoption of Demonstration Stations aims at the assistance of Fijian Agriculturists by supplying planting material, by collecting produce for marketing, by affording an occular example of what can be done in the way of soil management, by making advice readily available to them through the Fijian Assistant in charge, and by acting as an incentive to cultivators in the vicinity.

The settlers living adjacent to the Demonstration Station appear to be happy and contended and should ultimately prove excellent citizens as settled individual peasant farmers.

The Fijian settlers are fast gaining confidence in the efforts of the Department to better their conditions and the close contact afforded by the constant supervision given to the settlement is strengthening that confidence which should augment progress and cententment.

Since the establishment of the Demonstration Station the number of independent cultivators in the three adjoining districts has doubled and most of these men have not only undertaken the cultivation of a greater variety of crops but have also much improved their methods and the general lay-out of their holdings.

The importance of adequate housing and sanitary arrangements is stressed by example and has had a good effect.

The utilization of efficient tools and implements has also enabled individuals to cultivate and tend larger areas than before; and to give better attention to drainage, &c.

The demands for assistance with planting material, implements and advice has grown proportionately as the ideas involved have made their impression on the minds of the more enlightened men living within reach of the area. It is realized however, that the scheme is still in an experimental stage and that the problems, in their associations with native administration, land tenure and soil erosion, &c., justify, as they demand, much more experimental investigational work than has yet been possible

In this connection the following quotation from the Empire Journal of Experimental Agriculture is significant. Dealing with the " Introduction of Mixed Farming in Northern Nigeria," Faulkner and Mackie, after describ-

In this connection the following quotation from the *Empire Journal of Experimental Agriculture* is significant. Dealing with the " Introduction of Mixed Farming in Northern Nigeria," Faulkner and Mackie, after describing initial failure, state that:—

> "At the outset, therefore, of our renewed efforts the agricultural officers, plant breeders and chemists were constituted into a team of experimenters with instructions to investigate every aspect of the subject—their objective was to evolve a system of which every detail had been tested in field trials and experiments. Subsequent events have proved the wisdom of this procedure; and it is also found that the greater the progress we make in our extension work the more important the experimental work becomes. For now we have gained the confidence of the farmers we can less than ever afford to give any advice by precept or example, which is not based on certain knowledge."

With the recognition of these principles, it is possible to look forward with confidence to the increasing utility and value of the Demonstration Station as a dynamic force in establishing and maintaining a prosperous independent native peasantry in Fiji— and thus provide a practical solution to the ploblems araisng out of the slow but inevitable breaking-down of the communal system.

THE LIME REQUIREMENT OF FIJIAN SOILS.

By

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Government Chemist.

In an article in the *Fiji Agricultural Journal* (Vol. 8, No. 2, 1936) a general account was given of the advantages to be secured by maintaining a proper lime status in the soil. Observations were recorded also on the acidity of Fijian soils and attempts made at Navuso with coral sand, to secure an optimum soil environment.

In the course of soil survey work carried out in Tailevu, Navua, Koro and portions of Vanualevu, many determinations of the acid status of our soils have been made and in a few selected cases the lime requirement of the soil as determined by chemical methods has been secured.

In the following table the soils so far examined are grouped according to their pH. values:—

TABLE 1.

Locality.	Type.	pH. (Soil).	pH. (Subsoil)	Comments.
Tailevu ..	Characteristic alluvial ..	5·32 to 5·98	5·76 to 6·36	Higher subsoil pH.
Tailevu ..	Lighter coloured alluvials .	4·45 to 5·11	4·77 to 5·47	Impeded drainage. Higher subsoil pH.
Tailevu ..	Red soils reed covered (Tuff)	4·41 to 4·91	4·36 to 4·65	Lower subsoil pH.
Tailevu ..	Yellow red (residual andesitic).	4·30 to 4·84	4·74 to 5·55	
Tailevu ..	Red Yellow (residual basaltic).	5·79	7·12	Much higher subsoil pH.
Suva Princess Road.	Residual Marl Soils (old forest).	4·67 to 5·15	4·83 to 4·90	
Navuso ..	Lower Rewa alluvials ..	4·66 to 5·36	4·91 to 5·77	
Koro	Deep alluvials	6·29 to 6·61	6·04 to 6·97	pH. increases with depth to 4 feet.
Koro	Residual volcanic soils (Basalt ?)	6·46 to 7·67	...	Submitted by D. of A. no subsoils taken.
Malau . ..	Alluvial flats	5·15 to 5·28	...	Submitted by D. of A. no subsoils taken.
Malau . ..	Residual volcanic (Malau) .	7·82	...	Submitted by D. of A. no subsoils taken.

The table indicates that, with the exception of the basaltic soils of Koro and Malau, most of our soils are on the acid side and that extreme acid conditions, indicated by pH. values lower than 5, exist in many localities. Also it will be observed that, with the exception of a single basaltic soil from Tailevu, there is little difference in pH. between the surface and subsoil, to a depth of two feet. This point is more clearly indicated in table 2, which depicts the pH. values of soils from sleected profiles.

TABLE 2.

Profile locality.	Type.	pH. 1st foot	pH. 2nd foot	pH. 3rd foot	pH. 4th foot	pH. 5th foot
Wainivesi, Tailevu Series	Tuff with scrub	5·60	5·60	5·69	5·55	..
Princess Road, Suva Series	Marl. low fern .	5·15	4·90	4·76	4·69	..
Princess Road, Suva Series	Marl. low scrub	4·67	4·83	4·70	4·80	4·76

It is apparent that there is little change in acidic conditions to a depth of four feet and that deep cultivation such as subsoil ploughing will not rectify surface conditions.

The hydrogen ion concentration of the soil or pH. as it is conveniently described) has qualitative significance only in deciding the lime requirement of a soil. If the lime demand has been determined for a soil type either by field trial or laboratory methods then the pH. value may have quantitative significance for that type. Usually however, the pH. value which is readily determined with extreme accuracy by electrometric methods simply indicates that acid conditions exist and it is necessary in deciding upon the lime dressing required to make direct experiment.

Where experimental stations or demonstration plots are available the lime requirement can be determined by normal field experimentation. These field trials, however, take time to produce results. For advisory purposes therefore, several laboratory methods have been developed.

In this paper the results obtained with three such laboratory methods are described.

PERCIVAL'S METHOD.

(*Soil Science*, 1931, Vol. 32, pp. 459 to 465.)

In this method several lots of 60 grams of soil, air dried and crushed to pass through 1mm. sieve, are mixed with 0·06 to 0·48 grams of pure calcium carbonate corresponding to dressings of 1 to 8 tons per acre of the carbonate. After the addition of 60 ccs. of water to each sample the material is placed in separating funnels and air aspirated through the whole series for 20 hours. The pH. values are then determined and the results plotted against the amount of CaCO3 added. The amount of CaCO3 required to produce pH. 7, is interpolated from the graph.

PRESCOTT'S AND STEPHEN'S METHOD.

(*Journal Australian Council of Scientific and Industrial Research*, Vol. 7, No. 4, 1934.)

This is a modified Veitch method and consists in evaporating to dryness on the water bath several 30 gram lots of air dried soil charged with varying quantities of saturated lime water corresponding to definite field dressings. One portion is evaporated with distilled water alone. After drying during which the material is thoroughly stirred the soil is well mixed and ground to pass a 1 mm. sieve. The pH. values are then determined and the values obtained graphed against the corresponding quantities of calcium carbonate in the form of saturated lime water used. By interpolation to pH. 7, the corresponding quantity of calcium carbonate required can be inferred from the graph.

HUTCHINSON AND MACLENNON METHOD.

(*Chemical News*, Vol. 110, P. 61–62, 1914.)

Ten to twenty grams of soil are shaken with 0·02 normal Calcium-bi-carbonate solution for three hours in a litre bottle attached to an end-over-end shaker, the air being displaced with CO2 to prevent precipitation of CaCO3. The filtered solution is titrated with 0·1 normal hydrochloric acid and the amount of calcium carbonate absorbed determined by comparison with the titration value of the original calcium-bi-carbonate solution.

In table 3 there is recorded the comparison between an alluvial soil from Waindoi using the Percival and Prescott methods. The values obtained for a Tailevu soil of similar type to the Waindoi alluvial using the Prescott method is also recorded.

TABLE 3.

Soil No.	Method.	pH.	pH. 1.	pH. 2.	pH. 4.	pH. 5.	pH. 6.	pH. 8.
Waindoi 103	Percival	4·77	4·98	5·25	6·09	6·22	..	7·24
Waindoi 103	Prescott	4·77	5·03	5·07	5·74	..	6·31	6·63
Tailevu 134	Prescott	5·23	5·89	6·17	6·83	..	7·26	7·60

In the Table pH. 1, &c., refers to pH. values determined after addition of 1, 2, &c., tons of lime as CaC03 per acre of 2 x 106 lb of soil.

These results, when graphed and the values of the dressings interpolated at pH. 7, indicate a lime requirement of 7·2 tons per acre for soil 103, by Percival method and 7·8 tons per acre for soil No. 103 by Prescott's method. Fair agreement exists between the Prescott and Percival methods on soil 103, and it will be noted that the lime requirement of the Tailevu alluvials is somewhat lower than that of the Waindoi alluvials, the Tailevu soil by Prescotts method requiring only 4·4 tons per acre.

The Hutchinson and MacLennon method has been much criticised by various workers and although it may not have the precision of the Prescott and Percival methods and although its indication may vary somewhat with the quantity of soil used it is certainly a very rapid method and requires little attention. Moreover the opinion is expressed that the method if properly standardised is of distinct value in soil survey studies and that its indication, although a minimum as far as Fiji soils are concerned, has greater precision than pH. values. In table 4 are grouped a number of soils whose lime requirements have been determined by the Hutchinson and MacLennon method.

TABLE 4.

Soil No.	Locality.	Lime requirement.	Soil type.
122	Tailevu	3·1 tons per acre	Alluvial.
103	Waindoi . ..	5·9 ,, ,,	Alluvial.
111	Malau	2·5 ,, ,,	Alluvial
134	Tailevu	4·4 ,, ,,	Alluvial.
3	Lauthala ..	2·0 ,, ,,	Coastal soil.
6	Nasinu Exp. St.	5·6 ,, ,,	Marl (Lateritic).
8	Fiji Club ..	7·3 ,, ,,	Marl (Lateritic).

The lime requirement in this table is expressed as tons of calcium carbonate required by an acre of soil of 2 x 10^6 lb.

In comparing the Prescott method and the Hutchinson and MacLennon method on soils No. 103, and No. 134, it will be observed that the agreement is only fair in the case of soil 103, but excellent with soil 134. It will also be noted that that there is little correlation with pH.

The above figures further emphasise the lime requirement of the soils referred to in previous papers. Under present conditions the requirements for neutrality are very large particularly when it is realised that in some cases the real lime demand may be 100 per cent. greater than that recorded in laboratory experiments.

The lime status of the soil should be adjusted to the lime requirement of the crop and it is very seldom that soils require to be limed to complete neutrality from this point of view. As far as Fiji crops are concerned it would appear that pH. values from 6 to 6·5 necessitating lime dressings between 2 to 5 tons to the acre are required for citrus, banana, and sugar. For other minor crops and for pastures the economic return would not warrant the outlay, although light annual dressings from half to one ton per acre would benefit pineapples grown on the red soils and would probably show an economic return. As far as Fiji pastures are concerned it is considered that, until cheap lime can be obtained in quantity, it would be uneconomic to introduce a liming programme.

SUMMARY.

(1) The pH. status or intensity of acidity of several Fiji soil types is recorded.

(2) Profile pH. distribution of certain soil types susceptible of cultivation show acid condition up to four feet with little variation in pH. with depth.

(3) The acidity as determined by pH. values is correlated qualitatively with a lime demand.

(4) The lime demand as indicated by Laboratory methods recorded above show requirements varying from two to 7·4 ton per acre of 2×10^6 lb.

(5) Three methods of determining lime demand on a typical alluvial are compared and it is considered that although the Prescott and Percival methods have a sounder theoretical basis than the Hutchinson and MacLennon method, the latter if used intelligently, and under standardised conditions, can yield useful results particularly in soil surveys.

It is considered that until cheap supplies of lime are rendered available it would be uneconomic to lime for pastures or minor crops.

THE BIOLOGICAL CONTROL OF THE WEED CLIDEMIA HIRTA, COMMONLY KNOWN IN FIJI AS "THE CURSE."

By

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Government Entomologist.

INTRODUCTION.

THE history of the introduction and spread of the melostomaceus plant, *Clidemia hirta*, has, so far as the writer has been able to ascertain the facts, already been fully described and a number of reports issued upon the success which has attended the efforts to bring it under control by biological methods (*a—b—c—d—e—f—g—*). In consequence, the time now seems ripe to review the whole position briefly and to summarise the present state of affairs.

HISTORY OF WEED IN FIJI.

Briefly the plant is supposed to have been accidentally introduced into the Waimanu District of Fiji with coffee plants from Brazil, and certain slight distinctions between the British Guiana, Trinidad and Panama forms of the plant, observed by the writer when carrying out his investigation in those countries, support the view that it came from the mainland of South America. The writer has been unable to ascertain the exact date of the introduction, but it was probably between 1880 and 1886. The plant first began to appear as a low hedge along the wire fences (where the seeds had been dropped by birds) and spread with such alarming rapidity as to acquire the title of the "Curse." It invaded the meadow lands, where cattle would not touch it, and soon covered wide areas to the exclusion of all other vegetation, forming a dense matted growth, four to six feet high, through which the cattle were only able to keep open narrow tracks. It was almost equally at home in such permanenet plantations as rubber and coconuts and even invaded the dense native bush. So grave did the position become and so hopeless the task of keeping it in check by hand, that it was even proposed to offer a reward of £5,000 to anyone who would evolve a method of combatting it, an offer which was actually made for the control of another pest at that time, *Levuana iridescens*, the purple Coconut moth.

When C. H. Knowles was appointed in charge of the Department of Agriculture, he took the matter in hand and when the writer joined in 1919, had already located the home of the weed as Central or South America.

In that year reports were received that the plant had had a check in a part of the Waimanu district and the writer was detailed in November 1919 to investigate this check, which, incidentally, proved to be due to nematode worms.

Following on this work the writer forwarded pressed specimens of the plant and paintings of the flowers and seeds to the various Departments of Agriculture in Central America, and to the West Indies, hoping to ascertain the presence of any insect agency likely to assist in checking its ravages. Arising out of these inquiries, Urich of Trinidad discovered the thrips, which now bears his name, *Liothrips urichi*. He did not, however, place any very high value upon it as a control, and the matter rested for some time.

In 1927 T. H. C. Taylor, who was visiting Trinidad in connection with coconut scale control was instructed to investigate the matter further, and, as a result of this preliminary inquiry, reported favourably upon the action of the insect.

It was then decided to test the insect for undesirable habits, a local student, Cook, *k.* being detailed for the work. This officer found no bad habits, but expressed a somewhat pessimistic view as to the value of the insect as a control. In view, however, of the seriousness of the weed it was decided that the introduction should be attempted, the writer being instructed to carry out the work, which was commenced in October, 1929. When doing this two important points came out.

(1) That the Thrips was itself in Trinidad subject to heavy pressure from a number of previously unsuspected enemies, the elimination of which would enormously increase its efficiency.

(2) That the weed also had many other insect enemies in addition to the Thrips, these being chiefly seed destroyers. So that in the event of the Thrips proving insufficient, further biological pressure was possible.

The introduction of *Liothrips urichi* into Fiji was successfully accomplished in March 1930, and results have shown that the work of screening out its own enemies was completely performed.

The first releases were made at Lami and Nasinu in large solid areas of the weed, and for a little over a year no apparent progress was made. This was partly due to the unfavourable dry weather, but, no doubt, scattering has much to do with the apparent failure of the insect to make headway. This scattering, however, led to the formation of numerous small foci and with the return of normal conditions and suculent growth, the insect began to increase with astounding rapidity, crossing wide areas of sea and jungle (as much as 30 miles of open sea) and everywhere by its attacks on the terminal shoots stunting the weed, which then became overgrown and strangled by competing vegetation. The general effect was that by 1934 large ares of what had been dense curse had been replaced by a mixed growth, much of which was useful vegetation.

There still remained, however, considerable areas of the pest in certain very wet districts, such as Tholo-i-Suva, near Suva, the Tailevu and Salia Levu in Taveuni, and it was not until 1936 when the dry season was again exceptionally sunny and dry that the insect was able to make great headway in these areas, at least in the two former, although even in the Tailevu, where the dairy settlers regularly cut the plant the pressure of the Thrips upon the young growth had been sufficient to reduce weeding costs to one quarter.

With the dry season of 1936, however, the pressure of the insect upon the plant in these districts became so severe that at Tholo-i-Suva the competing vegetation was able completely to suppress the big area of old weed and to-day only isolated heavily attacked bushes remain in that district, whilst in the Tailevu the vast sea of *Clidemia* at the end of the settlement is now overgrown, and three quarters dead with good grass opening up in patches. In this area one farmer reported that a hill, which formerly cost him ten pounds a year for clearing had cost him nothing for the past two years.

REPLACEMENT.

In most places the weed has been replaced with useful grasses, para, &c., sensitive and Desmodium. At one place a good deal of Blue rat-tail was noticed, whilst at another *Urena Lobata*, another weed, was in evidence.

DETAILS NEAR SUVA.

Navua Road.—The big area below the old hospital is, except in one small corner, entirely replaced with para grass and Mimosa (sensitive plant).

From here to Lami old paddock it has quite gone. Lami old paddock was until recently solid curse, but this is now replaced with a mixed growth of Mimosa, Desmodium and grasses.

From this point out to about ten miles, the weed has gone, but from ten miles on reappears as isolated heavily attached bushes.

The sward of young seedlings on the clay road and drain facings at Lami and Visari has quite disappeared.

Princess Road.—From Suva to six mile, the weed has gone. At six mile the big solid areas on both sides of the road have been replaced with mixed vegetation which in turn is now being brought under cultivation. Isolated bushes show up from the sixth to eighth miles, where the big solid area which formerly existed has been entirely replaced by para grass and a mixed growth of fern. Opposite Sawani, where the owner cut the plant some two years ago, only a few dwarf isolated seedlings have come up.

Rewa Road.—The weed has gone from most of this area including the solid patches at Samambula and Nasinu.

Tailevu.—From the Rewa to the commencement of the dairy settlement the weed has almost entirely disappeared from the road side, the few plants seen being overgrown and dead or dying. At the end of the settlement the big solid area is now overgrown and largely dead, whilst it is opening out in many places into grassy clearings. On the Wainavesi road and at one other place there was a good deal of the weed in two or three paddocks. Inquiry elicited the fact that these areas were heavily stocked, so that competing vegetation had no chance.

FOREST CONDITIONS.

The dense shade of the forests, whilst not highly favourable to the pest, is less so to the thrips, and a good many weedy plants are to be seen. Such, however, yield few seeds and are of no economic importance.

SUMMARY OF POSITION TO DATE.

The thrips can now be said to have accomplished its task. The plant is no longer a Curse; hardly a weed, since it is now unable to compete successfully with the other vegetation. The writer is of opinion that a fluctuating balance can now be said to have been established over most of the infected area, isolated bushes sufficient to maintain a thrips population remaining, the number of such varying from year to year. There still remain a few, three quarter dead, stands of the weed. Such remaining areas have yet to be replaced with mixed growth, but the change is taking place rapidly and can always be hastened by cutting. These areas, however, being mostly somewhat unfavourable to the thrips are likely to support a larger normal curse population than most portions of the country.

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YANGGARA.

By

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How many people in Fiji realize as they sit in their comfortable seats at the "talkies" and watch with varying degrees of envy the full-blooded pictures of ranch life in America or station work in Australia, that there is similar life and work in reality almost at their own back door.

In particular Yanggara, the Colonial Sugar Refining Company's cattle and horse breeding establishment, typifies such life. Here, the visitor may see the varied phases of the stockman's work. Be he vocally proud of his horsemanship, he will be given a mount that may test his riding ability and disaster looms ahead if he has over-estimated such ability. Others like the writer, who modestly aver that they do not usually fall off unless the animal breaks too sharply into a walk, will be given an amiable steed that will ensure a safe if somewhat unexciting journey. He may even be honoured with "Taniela," a sagacious animal who although bereft of one eye can detect the shady side of a tree before its seed progenitor has even germinated; or "Mary" a masquerading gelding of aldermanic proportions.

A ride into one of the back paddocks during muster time will generally convince any discontented individual to continue in his chosen avocation rather than become a "cowboy." Always amongst these mobs are the "irreconcilables" who choose every opportunity to "break back" from the others. After them go the horsemen up and down hills of very steep grade till they get them back or lose them in the dense areas of scrub.

Work in the yards is varied and exciting during muster. Branding and castrating young stock, cutting out strays that have got into the wrong mob, with an occasional rebel animal all add to the variety.

Yanggara breed Hereford cattle for beef purposes for the Rarawai and Lautoka butcheries, light horses for supply to the various overseers and others employed by the company who require hacks, and draught horses for the various mills and their tenant farmers when the Company's need have been supplied.

The property is situated at the borders of Ra and Tholo North, some of the property lying in each province. For the greater part the land is devoid of natural trees but along the creeks good shelter trees occur, whilst the gullies and steeper hillsides in the back paddocks are often covered with dense undergrowth and small trees. Shelter trees in considerable numbers have been planted and are still being planted. The property is excellently watered with permanent running streams in all grazing paddocks. The rainfall is between 60–70 inches per annum, most of which falls during the summer months. During the winter months the property is occasionally subject to dry periods, during which anxiety is sometimes caused through comparative scarcity of food, but usually the place carries the stock (about 3,000 cattle and 600 horses) on it quite comfortably.

The breed of cattle decided upon by the Colonial Sugar Refining Company when they first took over Yanggara, was the Hereford. With that end in view Hereford bulls were imported firstly about 1927 also a few Hereford cows. Most of the cattle on the property at the time were mixed breed. From these cows and the Hereford bulls, supplemented at regular intervals by further imported Hereford bulls, a breed of cattle has been evolved which

are at present day showing only the Hereford characteristics. Difficulties were at first encountered in developing the type most suited to Fiji. This breed is peculiarly susceptible to eye trouble in Fiji, the most common of which are epithelimona or cancer of the eye, conjunctivities and keretitis, both of contagious origin and due to injuries which cause inflamation of the eyelids and surrounding tissue due to irritation. It is undoubted that the absence of pigment in the hair and skin around the eye is conducive to such conditions and the ultimate aim of the Company is to produce stock with a fair amount of pigmented hair and skin around the eye and thereby to increase the resistance to disease conditions. The breed otherwise are very hardy and eminently suitable for the purpose required.

Breeding is carried out on scientific lines, always with the view ahead of improving the quality of the herd. Each year the worst of the breeders are culled and speyed and replaced by the best of the young cattle developing into maturity. Good looking breeders too are culled if they are not producing calves up to standard. Only the best of the bulls are used for those breeding cattle from which the future breeding heifers are to be chosen.

The same thoroughness is maintained with the breeding of draught horses. The breed originally chosen as suitable for Fiji was the Suffolk Punch, a wise selection as these animals, although very weighty, are clean legged and not subject to as many foot and leg complaints as are the more hairy legged horses, as the Clydesdale and Shire horses, when they are called on to constantly perform work in wet areas. Moreover they are an active type of horse particularly suited for cane cultivation work. Many fine types of horse of this breed have been produced on Yanggara and they are eagerly sought for by tenants when available. Later, it was decided to try the Percheron breed, a similar type of animal, with equally gratifying results as to the quality of the offspring. Great care is also taken in the selection of young mares to replace old breeders or breeders not up to standard, so that the quality of the young horses bred on Yanggara is constantly improving. Those mares not required for breeding purposes and also the colts, after castration, are sold between the ages of three and four years for working purposes. It was noted that in one paddock there were over eighty 3-year old geldings of Suffolk Punch and Percheron breed. It is doubted if any establishment in Australasia could boast of an equal number of 3-year old geldings of these breeds. Imported sires are regularly used for breeding purposes whilst four Percheron mares have recently been bought in Australia with a view to improving the breed still more.

For the hacks, a thoroughbred sire is used and there are many useful and fine looking light horses bred on the property.

The quality of the soil varies considerably, some of the flat land adjacent to the river is of considerable depth and is all highly fertile. The soil of the rising land and hill country varies considerably in depth and from this point of view may be considered as comparatively poor land. Pasture, however, is quite fair on most of this area. Practically all the accessible land has been top-dressed within recent years, principally with superphosphate, with eminently satisfactory results. It is understood that the Colonial Sugar Refining Company have wisely provided for regular future top-dressing. It is apparent that since the application of superphosphate, there has been a notable decrease in " seed grass " in the pasture and a corresponding increase in better class fodder plants, particularly Desmodium.

Considerable effort has been expended in attempts to improve the pasture on the property by the importation of grasses from overseas and the intro-

duction of grasses from other parts of the Colony. It would appear that grasses already established in Fiji have shown up better and form the bulk of the herbage. The following grasses are of common occurrence, sensitive grass, (*Mimosa pudica*) tropical trefoil, (*Desmodium trifolium*) false thurston grass, (*Brachiaria distachia*) Malolo or Nawai grass (*Dichanthim sps.*) Paspalum, (*Paspalum dilitatum*) Love grass, (*Eragrotis pilosa*) and Caboni grass (*Amphilophys glabra*). This latter grass which forms the foundation of the pasture in the Yanggara area gives excellent young growth, but it tends to become rank in the dry season. Some 80 acres of para grass (*Brachiaria mutua*) now occurs on the flats.

Noxious weeds cause considerable worry but their eradication has always been carried out vigorously. Ellington Curse (*Acassia sps.*), a few years ago practically overran the Company's main fattening paddock, but constant work has generally reduced this pest to a point where control is reasonably easy, and has produced an excellent pasture paddock from a previous wilderness. Guava is the next most serious menace but is well controlled.

Yanggara is under the supervision of Mr. Allen, Manager of the Colonial Sugar Refining Company, Rarawai. For a number of years Mr. Victor Clarke has controlled the administration of the property. Recently Mr. Otley has been appointed as resident overseer under the supervision and guidance of Mr. Clarke. The labour is principally supplied by Fijians who do most of the general stock work on the property. These men having usually a liking for this class of work, become fairly efficient and some become quite good horsemen and are not afraid to try conclusions with an unruly young animal. Anyone doubting the capacity of a Fijian to engage earnestly in his work should observe the efficiency displayed by these men at Yanggara.

Thanks are due to the Manager of the Colonial Sugar Refining Company, Rarawai and other officers of the Company who have always given valuable assistance and information at all inspections of the stock and property. The Colonial Sugar Refining Company is to be congratulated on the fact that, whilst they do not profess any great knowledge of grazing and stock raising, they have attained a very high standard of efficiency, in all branches of the industry.

SOIL NOTES, KORO AND LAU.

By
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and
P. L. R. CHARLTON, Assistant to Government Chemist.

SEVERAL soil samples were taken during a visit of the Director of Agriculture to Koro and the Agricultural Officer, Islands, to Northern Lau. These samples were submitted for chemical examination and the results obtained are recorded in Table I.

The following Field notes were recorded.

Sample 78.—This sample was taken at Nathamaki, Koro, 100 yards from the shore at an elevation of 20 feet above sea level. The soil was a deep chocolate colour and of good depth and drainage. Erosion was not in evidence.

Sampe 79.—This sample was taken at Rickett's Estate, Lola on the island of Koro, 200 yards from the sea on a slope of about 1 in 7 feet. The elevation of this sample was about 30 feet above sea level and the soil was black coloured for a foot in depth followed by several feet of grey stony soil.

Sample 80.—This sample was also taken from Nathamaki, Koro, 200 yards from the sea at an elevation of 40 feet. The soil was brown in colour, drainage good, and erosion not in evidence.

Sample 81.—This sample was secured at Natamaki, Koro, 400 yards from the coast at an elevation of 60 feet above sea level. The soil was brownish coloured, of good texture and drainage, and no sign of erosion was noted.

Sample 85.—This sample was taken at Matuku (Lau) at an elevation of 15 feet. The soil was brownish coloured, of good texture, drainage and depth. The soil was covered with low scrub and was considered to be suitable for cotton, tobacco, kumalas and coconuts. Erosion was not noted.

Sample 87.—This sample was also taken at Matuku in the Lau Group at an elevation of 50 feet. Drainage, cover, soil depth and lack of erosion were similar to 85.

Sample 82.—This sample was secured from Loma Loma in Lau at an elevation of about 15 feet. The soil is a chocolate brown of great depth and free drainage. It was considered to be suitable for ndalo, cotton and coconuts.

Sample 84.—This sample was taken at an elevation of 50 feet, and had similar properties to 82. It was also secured at Loma Loma and was not considered to be suitable for ndalo. Erosion was slight.

TABLE I.

Soil No.	Locaility.	P.H.	C.S.	F.S.	Silt.	Clay.	Water	P_2O_5	K_2O	N_2
(85	Matuku (Lau) ..	7·58	29·4	23·4	20·0	19·3	6·7	0·130	0·329	..
(86	,, ..	6·24	32·3	19·0	18·0	25·2	6·3	0·110	0·227	..
(87	,, ..	7·50	9·3	13·6	18·3	49·8	7·4	..	..	0·32
(88	,, ..	7·20	9·5	11·4	24·0	54·0	3·6	0·064	0·076	..
79	Koro	6·46	2·2	21·9	31·3	39·5	5·5	0·100	0·075	0·117
80	,, ...	6·89	Nil	2·7	20·0	75·1	4·2	0·244	0·099	0·176
81	,, ...	7·67	3·0	8·1	57·4	27·9	4·6	0·320	0·087	0·322
78	,, ...	7·50	14·4	6·4	12·8	59·0	10·1	0·560	0·188	0·330
(82	Loma Loma (Lau)	7·67	18·1	20·3	28·0	31·1	4·0	0·097	0·410	0·113
(83	,, ..	7·48	22·7	20·2	34·4	21·1	3·8	0·082	0·367	..
84	,, ..	7·24	21·3	17·6	25·8	31·7	5·5	0·111	0·256	..

Bracketed soils indicate soil and subsoil in serial order. Mechanical analyses were carried out by the Robinson Pipitte technique and the particle size is that adopted by the International Socitey of Soil Science. Phosphorus potassium and Nitrogen were determined by normal technique.

OBSERVATIONS ON CHEMICAL AND MECHANICAL ANALYSES.

Matuku.—From the table, soil 85, approximates in comparison to a sandy loam with a somewhat heavier subsoil. Potash figures are good but Phosphate is only medium and decreases a little with depth. It would appear to have an ideal texture and good retentive properties. Soil 87 is heavier in texture as indicated by mechanical analysis and corresponds to a medium clay loam. It would appear to have greater retentive powers than (85). As with subsoil (86) the subsoil (88) is somewhat heavier than the soil. The nitrogen content of (87) is excellent.

Koro.—Soil (79) is a loamy clay of medium clay content and would appear to possesses a good texture and fair retentive properties. The high silt might occasion some difficulty in working. Phosphate and Potash are only fair and Nitrogen is medium in value. Soil (80) is a heavy clay loam with excellent Phosphate, medium Potash and Nitrogen. Soil (81) is a heavy loam with medium clay. It would probably be difficult to work and possesses high retentive properties. It has excellent Phosphate and Nitrogen, but the Potash is on the low side. Soil (78) is a medium clay loam somewhat lighter than 80 and possesses excellent Phosphate, Potash and Nitrogen values. It appears to be the most fertile of a series of fertile soils.

Loma Loma Soil.—These Lauan soils are of good texture, of the type of light loam. They possess similar silt and clay values which might occasion some difficulty in working. The chemical values indicate fertile conditions.

The table indicates that with P.H. values varying from 6·24 to 7·67 the lime status of these soils is extremely good, and in general the chemical and mechanical values are good. The mechanical condition of (85) (79) (81) (82) might lead to difficulty in working, particularly in wet weather. In these soils the silt in relation to clay is equal to or greater than the clay figure. The worst offender is Koro (81) which contains 57·4 per cent. silt and 27.9 per cent. clay. The texture could be improved by green manuring followed by ploughing in to increase the soil colloids.

It is with pleasure that we acknowledge the assistance in the laboratory of Native Assistant Vilitati Vavaitamana.

THE GIANT TOAD.

By

H. W. SIMMONDS, O.B.E., F.R.E.S.,
Government Entomologist.

As recorded in the last issue of this Journal colonies of this toad (*Bufo marinus*), received from Lautoka, were released in May and June 1936, in Suva, Nasinu and Navuso. These were the progeny of those imported the preceding February from Honolulu and were all small.

On January 31st, 1937, a few tadpoles from these were observed in the stream at the bottom of the author's garden in Suva and within 48 hours these had increased to several thousands.

They were black in colour and exceedingly small, measuring less than 10 mms. Some 1,500 tadpoles were collected and placed in local ponds, rice fields, &c., out as far from Suva as Ra. Of the balance left in the stream all moved down to the small drain which passes through the Cricket Ground whence, on the night of the 8th–9th February, heavy rain floods swept them out to sea. A few kept in the Laboratory for observation developed legs and left the water from the 16th–18th taking about seventeen days only in the tadpole stage.

At Nasinu in the cooler weather of April–May, the Agricultural Officer South (Mr. H. R. Surridge), reported that he observed spawn on a submerged grass bank between two still pools on April 20th. This was in the form of a clear, gelatinous rope about $\frac{3}{8}$ inch thick. Tadpoles were observed on the 24th–25th and by May 7th they began, after 14 days, to show their legs, reaching the adult stage and commenced to leave the pool on the 16th.

Several young toads, less than 12mms. in length, black in colour and with minute yellow spots, were released by the stream in the writer's garden on the 18th February and on the 26th March 1937, two about two inches long were observed in the garden, being probably two of these. It will thus be observed that from date of spawning to maturity and the next generation has under Fijian conditions, been not more than eleven months.

The toads spawned again in March, this time lower down in the Cricket ground and were again swept to sea, this time before the writer was aware of their presence. Four other spawnings took place for certain, two at Nasinu and two in the pool at the Botanical Gardens and it is thought that a reasonable proportion of both these reached the stage of leaving the water, several 1–1$\frac{1}{4}$-inch specimens having been observed about the gardens some six or seven weeks after this spawning. Whilst it is unfortunate that the frequent floods at this season made the stream in Suva a somewhat precarious breeding place, the short tadpole stage, seventeen days, should, when the toad population becomes greater, enable many broods to mature between floods.

A mature female toad, run over by a motor-car at Nasinu was examined for its stomach contents. This specimen had full ovaries being just ready to spawn. The stomach contained three slugs, one snail, one centipede, two Rose beetles, three millipedes besides small stones and a few stems of grass. It will thus be realised what a boon this amphibian will be when its numbers become sufficiently great.

It will give some idea of the slug population of Suva, that the writer has been able to destroy nightly, in his garden some 200–300 of these vermin,

and estimates that he has killed between 20,000 and 30,000 in the past five months on about three-quarters of an acre of lawn and garden. So that there is ample room for a consideralbe toad population.

A colony of 50 tadpoles collected in the Botanical Gardens was despatched to Mua, Taveuni on the 15th April, 1937. This being the first batch to be sent to that Island and on May 11th a colony of about 200 tadpoles was forwarded to the island of Rambi.

THE HAWKBILL TURTLE.

By
C. R. TURBET, M.R.C.V.S., B.V.Sc.,
Senior Veterinary Officer.

It has always been the habit of the hawkbill turtle (*Cheloni imbricata*) to use the island of Makaluva, situated about eight miles east of Suva as a breeding ground. Having in mind therefore the value of the shell which is derived from this turtle an arrangement was made by the Director of Agriculture for initial experiments with a view to the adoption of protective measures for the species.

It is a well known fact that few newly hatched turtles survive the first day of free life owing to the depredations of carnivorous fish and birds. Hence an attempt was made to study the feeding habits, shell changes, &c., by keeping newly hatched turtles of the above variety in captivity until such time as they would, by their increased size and ability to feed, be able to survive.

Mr. Beveridge, caretaker of Makaluva, kindly undertook to supervise the initial trial of caring and feeding the young turtles, with the assistance of the labour available on the island.

Accordingly the young from the hatchings of two lots of eggs were kept confined in a large wooden trough. It was found that the very young turtles were unable to submerge to the bottom in deep water. The depth of the water was therefore lessened and sand was added to the bottom of the trough.

Various forms of seaweed was fed as well as shell fish occasionally. The water was changed twice daily so that the conditions under which the young turtles were kept were good. Nevertheless, they failed to thrive and all except four died.

The cause of death was starvation due to unsuitable diet.

In consequence, twelve young turtles were brought to Suva and kept at the Agricultural Department under conditions not so good as those existing at Makaluva. Of these, four died the day following their arrival at Suva. The remaining eight thrived excellently on a diet of shell fish and beef in about equal proportion and increased their weights by approximately 300 per cent. and in size by about 200 per cent. in two and a half months, when their shells had become tolerably strong and hard.

This preliminary experiment indicates that much could be done to improve the supplies of our turtle shell if young newly hatched turtles could be collected and protected from the natural enemies until their shells were hard enough to afford the natural protection.

GENERAL NOTES.

TREE PLANTING.

In connection with a suggestion that the Coronation should be commemorated by the planting of trees and shrubs, it is of general interest to state that on Coronation Day 637 trees and 270 cuttings of ornamental trees were planted by various schools, &c., in the Colony.

The planting materials were supplied by the Department of Agriculture and reports indicate that most of the plantings have "struck" well.

POINT ROAD.

A programme of tree planting has been started along the Point Road where the high salt water table and the constant strong winds preclude the use of many of our best flowering trees. It is however, hoped that the planting of coconuts and other wind resistant species will in time afford the necessary shelter for the less robust and more showy flowering species. In the meantime it is considered that coconut palms and a small number of Norfolk pines and New Zealand christmas trees will prove attractive to the inhabitants and to visitors to our shores.

In this connection a plea is made to the public to afford these trees every opportunity to thrive well so that they may grow into shapely ornamental trees and so amply repay the cost of planting and maintaining them.

CATTLE FROM AUSTRALIA—IMPORTATION PROHIBITED.

Owing to the outbreak of a disease known as Three-day sickness or Ephemeral Fever among cattle in Australia, the importation of cattle into Fiji from that country has been temporarily suspended. It is impossible to say how long it will be necessary to keep this embargo on Australian cattle, but stock breeders will realise that the action taken is in the best interests of cattle owners in Fiji. Just as soon as it is considered safe to do so the embargo will be removed.

2. The disease has a low mortality. Not more than three per cent. of affected animals succumb but when newly introduced into a country where cattle have no immunity whatsoever the fever is severe and the great majority of animals contract it.

3. Insects such as mosquitoes are said to be the carriers of the disease which resembles dengue fever of man in many respects.

CITRUS.

Exports of these fruits to New Zealand were favoured with good prices during the past two months, thanks to a shortage of supplies. For the first time on record, grape fruits were exported to the extent of 110 cases and realised remunerative prices. For an intelligent and painstaking grower it is anticipated that grape fruit will become a profitable export crop in the next few years and the Department of Agriculture is endeavouring to stimulate its culture.

ANNATTO.

The New Zealand Co-operative Rennet Company at Eltham has under construction a new modern cheese factory costing over £6,000. In this building will be included a laboratory for research into cheese problems including tenner and cheese colouring substances. One of the raw materials used in colouring cheese in annatto and for this product there is a small but constant demand at economic prices.

The plants grow to production in two years with little or no attention, and form useful ornamental hedges. The work required in the collection of the ripening pods, just before they burst, is slow but easy. The pods are then dried and the seed threshed out and cleaned before bagging for export in as fresh a condition as possible.

Efforts are being made to secure this small market in Fiji and those interested should communicate with the Department of Agriculture through their Divisional Agricultural Officers.

PUBLIC HEALTH REGULATIONS.

The new Public Health Regulations made by the Central Board of Health and published in the *Fiji Royal Gazette* No. 24 of 1937, mark a decided advance in Public Health Administration. The Regulations are now made to apply throughout the Colony whereas previously they only applied to Suva area. The uniformity thus attained should greatly facilitate the administration of the Regulations.

2. The duties of Medical Officer of Health and of Sanitary Inspectors are defined in these regulations. Sections of interest to Agriculturists and animal owners, are those relating to Slaughter Houses and Meat Inspection, Dairies, Tuberculosis in dairy herds and the keeping of animals.

3. The method of slaughtering cattle in slaughter houses provides for the use of humane killers but in certain cases a shot gun may be used.

4. All dairies must now be registered with the Local Authority of the Sanitary district in which the dairy question is situated. Similarly all cattle in registered dairies must now be tuberculin tested at Government expense by a Government Veterinary Officer.

DESTRUCTION OF THE BED BUG.

A promising advance in solving the problem of the destruction of bed bugs is reported in the *British Medical Journal* of February 27, p. 459, by Messrs. S. A. Ashmore, of the Government Laboratory, and A. W. McKenny Hughes, of the Natural History Museum, acting for the Committee of the Medical Research Council.

The authors put forward a simpler method with which they have had promising results both in the laboratory and in about two hundred infested houses. It consists in spraying the room at a temperature not below 60° F. with a quantity of fairly high boiling coal-tar naphtha for which a specification is given, the room being thereafter sealed for eighteen to twenty-four hours. It is claimed that this substance is not only lethal to the insects, but is also an ovicide and that it is not harmful to other animals. The concentration of vapour necessary is well below that of the flash-point of its mixture with air. Research is going on at the Field Biological Station of the Imperial College of Science to determine which of the many constituents of this coal-tar naphtha is specially efficacious, but the above-quoted report points to a remedy, by the careful use of a cheap and easily obtained product. It is greatly to be hoped that this method proves successful, for this social evil is a very great and widespread one. – (Extract from *Nature*, Vol. 139, No. 3521.)

BROOM MILLET.

Two varieties, namely, Scarborough Dwarf and White Italian were planted in the nursery in Singatoka in May 1936, from imported seed. Despite very dry conditions during June, July and August some good quality heads were harvested in September. The brush was used in making a number of brooms, both large and small. The handles were made from Fiji Kauri

(Ndakua) and the string used in sewing was made by hand from Hibiscus fibre grown at the Station. The brooms were shown as Departmental Exhibits in the Suva Show in October (1936) and drew favourable comment.

A number of plants of each variety were selfed to provide pure seed for the next planting. In October one row of each variety was planted with acclimatised seed. Excellent germination was obtained and the plants made rapid growth. The first lot of heads were harvested during the middle of December, 67 days after planting. The second lot was harvested two weeks later.

The second sowing from acclimatised seed was made on 15th December. Fair germination was obtained and the young plants are making satisfactory.

It is proposed that when sufficient brush is in stock an attempt will be made to manufacture brooms on the lines of a cottage industry. The brush appears to be of excellent quality and good colour and quite the equal of the imported article. It may be worth while introducing such an industry into the Prisons to provide brooms required by Government Departments, the brush to be grown by the Experiment Station, Provincial Schools and such like.

ADVANCES TO FIJIAN AGRICULTURISTS.

Under the scheme of agricultural advances to Fijians in the Western Agricultural Division the following list of implements has been issued during the last few years:—

Ploughs	58	Harness sets ..	25
Harrows	24	Bars	7
Cultivators . ..	21	Bullock chains ..	10
Disc coulters ..	19		

Repayments of the amounts represented by these advances are being made at approximately twenty per cent. per annum, which is reasonable.

It may be mentioned that all advances are given in kind (implements,, &c.) and none in cash.

PULSES.

Three types imported from India all showed rapid growth under Singatoka conditions, recently giving quite satisfactory crops. Selections of the three types have been made for further experiment, some of them showing very good promise as an adjunct to local pulse supplies.

INDIAN SETTLEMENT AT NDOMBUILEVU.

This Settlement comprises fifty-six men, forty-six women andeig hty-eight children and already one store has been erected in addition to sufficient houses for the various families. The Settlement has the advantage of the presence of one particularly progressive man whose farm has already become a model with well placed drains and a variety of field and garden crops.

The main plantings so far include rice, ndalo, tapioca, mungh, yams, maize, and cotton.

The settlers have made very good progress in a short time in fencing their lands and getting their food crops planted and they are gaining confidence in the Officers of the Department of Agriculture.

POULTRY.

A rooster and eight hens of the Australorp breed imported during 1936 for the purpose of improving the breeds of local poultry, are breeding well and producing satisfactorily. Already a considerable number of settings have been sold at reasonable prices and distributions have been made to various agricultural stations for multiplication so that the utility of the import is certainly promising.

TUBERCULIN TESTING.

As a result of the application of the tuberculin test to Suva dairy herds the incidence of tuberculosis in cattle in the Suva area has been reduced from 18 per cent. in 1931 to less than one per cent. in 1936—a most satisfactory state of affairs.

COTTON.

Reports recently to hand show that Fiji grown Sea Island cotton has been given top London prices for the grade again this year. In addition, Fiji hybrid cotton has gained 14 pence per lb which is quite satisfactory. The reports indicate that Fiji grown cotton is a good commercial product and only requires to be produced on a larger scale for the benefit of the Colony.

FIJIAN PEASANT FARMERS.

In Tholo West there were, in 1936, ninety-three " exempted " Fijians of whom seventy-nine were actively and contentedly engaged on their own lands in agricultural and pastoral pursuits. All these seventy-nine men now have their own houses and own in the aggregate 365 horses, 603 cattle, 99 pigs, 474 fowls, 23 goats while they have 259 acres under cultivation comprising 107 acres of food crops, the balance of the total area being occupied by yanggona, maize, rice, cotton, and tobacco.

These figures indicate a healthy state of affairs in this Province and appear to warrant the extension of " exemption " privileges to as many men as are capable of working independently.

DEMONSTRATION STATION, NDOMBUILEVU.

This station is in process of establishment and consists of thirty-five acres of good average land ideally situated as a demonstration area, with a long road frontage on King's Road.

The area has been fenced, partially cleared, and a small part planted with food crops and cotton, while a nursery area has been laid out. A " mbure " has been erected for the Native Field Assistant in charge and the preliminary work well advanced for the next planting season.

Distribution of seeds and planting material is already taking place from this centre to the adjacent Fijian Settlement where fourteen men have recently commenced work on the land. These settlers are naturally encouraged to plant their food crops first, attention later being paid to cash crops. Many of them appear to be showing good promise of becoming useful peasant farmers.

PASSION FRUIT.

The demand for passion fruits and for tinned passion fruit pulp has recently increased considerably in England, New Zealand, and Australia, and should present possibilities for local cultivation. The soft skinned fruit types grow abundantly in some areas and would provide good pulp for export while the hard skinned types could be used either for pulp extraction or for export as fruits. Information regarding cropping abilities of the various types occurring in Fiji is being collected and any definite figures of yields by local growers will be very welcome if sent to the Department of Agriculture.

TOBACCO.

Approximately 8,000 lb of Fiji " stick " tobacco were sold remuneratively in Fiji in 1936. This trade is in its initial stage but should continue to develop slowly and thus afford a small market for locally produced Fijian leaf. The export market for this product is still under experiment, many difficulties being experienced.

REVIEWS.

PLANT BREEDING ABSTRACTS, SUPPLEMENT II, SUMMARY OF REPORTS RECEIVED FROM STATIONS IN THE BRITISH EMPIRE 1932–35.

(Imperial Bureau of Plant Genetics, Cambridge, pp. 63, 5s., April, 1936.)

THIS supplement to *Plant Breeding Abstracts*, also a publication of the Bureau, represents the result of a tremendous amount of work undertaken in collecting, collating, and indexing and presenting in a concise form, information relative to all phases of plant breeding to be found scattered throughout some 400 Annual Reports of Departments of Agriculture throughout the British Empire.

The general layout makes it a most useful book of reference, of general interest and value to research workers and particularly to those workers who are situated in the distant parts of Empire where facilities for contact with those doing similar work and access to relative literature are at a minimum.

In general, the Annual Reports of a Department of Agriculture represent the chief means the average research worker has of securing publication of his work and its results. Such reports have a restricted circulation, hence the activity of the Bureau in rendering such work available to all concerned in plant breeding is of particular value.

The publication covers a wide range of climate and crops, other than herbage; includes references to diseases, pests and their control; plant breeding, genetics and cytology; all planned to render reference easy and complete and the book is well indexed.

Such reviews are invaluable to all those engaged in plant breeding and modern genetics in relation to agriculture in giving a comprehensive survey throughout the whole field of plant breeding.

A similar review is in process of compilation from reports received from countries outside the Empire and will complete make a valuable contribution to plant breeding works of reference.

—H.R.S.

CULTIVATION OF CITRUS IN CEYLON.

By

T. H. PARSONS, F.L.S., F.R.H.S.,

Curator of Royal Botanical Gardens, Paredeniya, Ceylon.

(*Tropical Agriculturalist*, Vol. 87, No. 3, 1936.)

THE article is stated to be a revision of leaflet No. 59 of 1930.

Interest is being slowly stimulated with consequent increase in acreage of this crop, but not sufficient to make citrus a major crop. Areas are available where conditions would appear to be favourable. Capital is required as well as a rigid insistence on the use of the best material and methods.

Some statistics as to cropping areas and production for the main producing countries are given, including the increases recorded for South Africa, Jamaica and Palestine for the period 1930–34. It is pointed out that only one per cent. of the world's output is produced between latitudes 20° N. and 20° S. of the equator, the other 99 per cent. coming from between latitudes 20° and 40° in both hemispheres.

Ceylon being situated between 6° and 10° N. of the equator would appear to be outside the normal citrus belt but the varying climatic conditions of

its highlands make it comparable with Jamaica where under similar conditions cultivation and production is extending, provided suitable types and varieties are obtained and proper cultural methods adopted.

Stocks suited to Ceylon are discussed. It is pointed out that the local fruit is coarse, thick skinned and invariably green when ripe due partly to inherent characters, heavy rainfall, lack of cultivation, tropical environment bad drainage, &c.

Methods for the improvement of fruit through budding are indicated.

Reasons for the variation of yield of different trees within an orchard are offered and the characters of Ceylon stocks considered of importance owing to being invariably of seedling origin.

When seedlings are budded it is stated that the scion has a levelling effect on growth and performance, therefore the necessity for discarding all seedlings other than those of regular size and appearance is emphasized. A budded or grafted tree is not necessarily superior to a seedling tree but the stock may be more hardy in the sense that it may resist cold or heat, excessive moisture, &c., better than the parent tree.

Stocks suggested by experiment are the Sour or Seville orange, pumelo and rough lemon. Sweet orange has been largely discontinued as a stock, owing to its susceptibility to "*Mal de Goma.*"

Rough lemon and sweet lime are of rapid growth and carry early fruiting qualities to the scion, are strong rooting and withstand drought; a disadvantage is that these stocks are shortlived, particularly in the moister zones. The pumelo and sour stock, however, are slower in coming into bearing but much longer lived.

Imported plants from reliable outside sources are recommended to secure a supply of proved budwood.

The general conclusions arrived at from experiments undertaken at Peradeniya are that the following stocks are recommended:—

1. Rough lemon, pumelo, sour orange and possible the lime for low country and moist conditions.
2. Sour orange for up country, moist and semi-dry regions.

VARIETIES.

Oranges.—The four main groups in cultivation are:—Spanish, Mediterranean, Blood and Navel, of which the Navel predominates in Ceylon. Varieties generally in cultivation are—W. Navel, Mediterranean Sweet, Valencia Late, Pineapple, Jaffa, St. Michael and Malta Blood. The Jaffa and Mediterranean Sweet bear early fruits, W. Navel, Pineapple and Malta—mid season, the remainder late season fruits.

Of mandarins, the "Indian Nagpur" is recommended for all low country conditions being loose skinned and able to withstand the extreme heat well. Under Indian conditions it is a double cropper but under the semi dry conditions of Ceylon, bears once a year only. It is stated to be equal to the famous "Dancy" mandarin of California and Florida.

The "Sylhet" orange, an Indian tight skinned variety is highly commended together with the "Emperor" and "Beauty of Glen Retreat" which require some elevation for the best results.

Eureka, Lisbon and Villa Franca lemons are varieties well suited to most parts of Ceylon, irrespective of root stock.

Limes are stated not to pollenate freely therefore budding is not so essential. Seedless limes however must be budded.

The cultivation of grapefruit is most successful in the warmer and moister low to mid-country districts provided there is good drainage. Stocks recommended are sour orange, pumelo and possible rough lemon.

" Marsh Seedless " variety is preferred on account of its seedlessness, robustness on various stocks and adaptability to varying conditions.

Other varieties grown are:—Walters—considered earlier than the " Marsh "; McCarthy, Pernambuco, Cecily's seedless and Triumph, in order of importance.

PROPAGATION AND PLANTING.

Propagation is by budding. Seed of thoroughly ripe fruit from strong healthy trees is extracted, graded, only the plump, heavy seed being sown, the remainder discarded. The seed is not allowed to become dry and should be washed before planting.

The seed bed is carefully prepared in good soil, well drained and sheltered. When seedlings are 4 ft.–6 in. high they are transplanted into rows 12in.–15.in apart using only the strongest and best, and of uniform size.

Budding and bud selection is described and it is stated that the best results are obtained under light to moderate rainfall.

The " Rectangular " or " Patch " budding, the upright and inverted are recommended, the latter giving the best results at Peradeniya.

PRUNING.

The reasons, objects and methods of pruning are discussed in general and the difficulty of the problem with reference to citrus is indicated, the recommendation being to prune first to shape the tree, then to use the knife as little as possible afterwards except for the removal of dead wood and branches obviously in the way, but having due regard to the shape of the tree.

MANURING.

Light dressings of farmyard manure are recommended and also an annual dressing of from 4–8 lb per tree of an artificial fertiliser mixture containing N : P : K in the proportion 4 : 2 : 1.

CROPPING.

Budded plants should begin to bear at the third year from budding, grape fruit at the fourth year in moist zones if the stock is pumelo or sour orange.

The first crop should not be allowed to exceed 8–12 fruits per tree, while full crops comprise anything from 300–600 fruits per tree, an exceptional tree may produce 1,000 fruits per annum.

The unit of production is the individual tree, there being good and bad bearers.

—H.R.S.

ON THE SEEDLESSNESS OF CITRUS FRUITS WITH PARTICULAR REFERENCE TO MARSH GRAPE FRUIT.

By

N. WRIGHT,

(*Trop: Agriculture*, Volume 13, No. 5, May 1936, and reprinted by *Trop: Agriculturist*, Volume 87, No. 1, July 1936.)

CLOSE competition and the rigorous standards demanded by the fruit market is held largely responsible for the attention now being given by citrus growers to the problem of " seedlessness."

The mechanism of fruit development in citrus species is peculiar and is not shared by the majority of other fruit trees. Structurally the fruits are all many seeded and in the more primitive varieties the ovules readily develop when either self or cross pollinated but, if not pollinated fruit does not develop.

In the more highly developed varieties failure of seed formation does not prevent fruit development—which is then said to be parthenocarpic. Such varieties are potentially seedless although seeds are often found in them. Such a result is due to a variety of factors of which self-sterility and cross-sterility are perhaps the most important.

Sterility may be due to structure involving the ovules (female sterility) or the pollen (male sterility) or both, which may be partial or complete. Almost complete structional sterility occurs in the Washington Navel and Satsuma oranges, the young ovule seldom reaching maturity and no viable pollen being produced.

Investigations into four varieties of tangerine with fertile pollen showed they produced fully seeded fruits on cross pollination but completely seedless fruit when self-pollinated, demonstrating that irrespective of the condition of pollen, partial female sterility reduces the number of seeds produced and complete female sterility results in complete seedlessness. Male sterility of like character would produce similar results. A further complication is the formation of " apogamic " seed which may develop without fertilisation the progeny being identical with the mother plant from which it was derived by vegetative growth.

The " Marsh " variety of grape fruit may be called commercially " seedless," it is recorded as containing from 2–6 seeds or more, but opinion has it that it may contain as few as twelve or as many as forty to eighty seeds, suggesting varying conditions of seed formation and the question as to whether the seeds are of apogamic origin or the result of fertilisation.

The foregoing indicates that a seedless fruit must be at least self-sterile but if such fruit developes seed then the cause may be two-fold:—

either it has been pollinated by a cross fertile variety,
or it has acquired self-fertility through a genetical change in its constitution—a mutation or sport.

In the Tahiti lime, which is classed as a completely seedless variety investigations indicate that the structure of the flower renders seed formation impossible; this also applies to the Satsuma orange but in this case cross pollination is a possibility. The work of other investigators suggests inconclusively that the " Marsh grape fruit," Lisbon lemon and Sweet lime are harmless to some citrus, while Valencia late, Baladi, Duncan, Yusuf effendi tangerine, and sour orange cause appreciable increase in seediness.

Controlled hand pollination experiments using pollen of the above varieties produced increase of seed as compared with self pollination, varying from 2·1 to 5·0. The author also presents figures indicating that trees giving large numbers of seeds have more viable pollen than trees yielding sparsely seeded fruit. Finally his observations on annual variations in seed content of a single tree suggest that weather conditions may be responsible for variation is seediness.

Observations on the seedlessness of pumelos may serve to indicate the habit in the grape fruit—their nearest relative. Thus, in Siam, the largest crop is picked in November . . . . . " though at other seasons the fruits are more seedless." A photograph of two half fruits taken from the same tree but at different times of the year shows one completely seedless and the other fully seeded. Also trees have been observed bearing seedless fruit except on branches extending towards other varieties of regular seed producing habits. It is recorded that seedless varieties of Siamese pumelos introduced into the Philippines produced large numbers of seed in normal

sized fruit, undersized fruit being more or less seedless. Cross fertilisation is the suspected cause of this seediness, a suggestion strongly supported by Hawaiian experience in which fruit from the spring crop, set at a time when few other citrus varieties are in flower is seedless, whilst the " main crop " fruit set when other citrus trees are in flower is heavily seeded.

Bud mutation is relatively frequent in citrus but it is significant that only in Marsh Grape fruit was a mutation found affecting the seed content of the fruit. Of 500 trees examined 123 gave fruits yielding 30–90 seeds per fruit. Two strains were recognised—a " Rough seedy " and a " Smooth seedy." The principal characters of the two strains are enumerated and afford the most definite information yet available with reference to a mutation affecting seed content.

The foregoing remarks indicate at least two sets of circumstances, which separately or together may offer a reason for the increase of seed content in a " seedless " variety of citrus, but it is necessary to be certain which variety is concerned. The remedy will therefore, depend upon the most important of the factors which experiment might reveal.

The tree that consistently bears seeded fruit should be regarded with suspicion and efforts should be made to trace the origin of budwood before use and in rebudding care should be taken to exclude foreign pollen from the tree.

The remedy consists in either replacing the tree by another; or by top-working the existing tree, the choice depending on the age of the tree, number of trees to be dealt with &c.

If seediness of the fruit is proved not to be transmitted by budwood, then it is suggested to " concentrate first on the possibility of cross pollination." by congenial varieties near to or within the orchard, the factors to be observed being flowering time and its coincidence with the period of grape fruit bloom. Such trees should be removed.

Mixed orchards should be avoided and efforts should be made to eradicate other varieties when recognised, even reputed " seedless " types since their pollen although self sterile may be fertile to the variety under cultivation.

Attention is drawn to the possibility of both cross pollination and mutation operating together. A single mutant tree or even only a limb may produce seediness in a number of trees growing near to it.

Growers are advised to check seedlessness in fruit by counting the number of seeds found in a representative sample from each tree. Trees bearing seeded fruit should be marked and the crop marketed separately. Also such trees should be examined to determine if only one branch is affected. Counts over a number of seasons will be necessary to confirm seediness and if proved the branch or tree should be removed.

In conducting preliminary investigations into seediness 25 fruits per tree is suggested as sufficient to prove real differences between two trees in 95 per cent. of cases. Such a sample should comprise fruit from all parts of the tree during the fruiting season.

As regards pollination experiments—intensive work on a few trees will probably yield more valuable results than a number of scattered pollinations over a wide area.

In conclusion it is stated that the solution of the problem of seediness is not a simple one and that only carefully recorded and controlled experiments will give essential results.

—H.R.S.

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